

16.—*On Cretaceous Cephalopoda from Zululand.*—By L. F. SPATH,  
M.Sc., F.G.S.

(With a Sketch Map, 4 Text-figures and Plates XIX to XXVI.)

CONTENTS.	PAGE.
I. INTRODUCTION . . . . .	219
II. THE UMKWELANE HILL FAUNA . . . . .	224
DESCRIPTION OF SPECIES:	
A. AMMONOIDEA:	
Family DESMOCERATIDÆ:	
Gen. <i>Parapuzosia</i> , Nowak.	
1. <i>P.</i> sp. nov. ? ind. . . . .	224
Gen. <i>Parapachydiscus</i> , Hyatt.	
2. <i>P.</i> sp. nov. aff. <i>colligatus</i> , Binkhorst sp. . . . .	226
3. <i>P.</i> cf. <i>wittekindi</i> , Schlüter sp. . . . .	229
4. <i>P.</i> sp. ind. . . . .	231
Family PRIONOTROPIDÆ:	
Gen. <i>Mortoniceras</i> , Meek.	
5. <i>M.</i> <i>woodsii</i> , sp. nov. . . . .	232
6. <i>M.</i> aff. <i>umkwelancuse</i> , Crick . . . . .	234
7. <i>M.</i> sp. aff. <i>soutoni</i> , Baily sp. . . . .	235
Gen. <i>Pseudoschloenbachia</i> , nov.	
8. <i>P.</i> <i>umbulazi</i> , Baily sp. . . . .	240
9. <i>P.</i> <i>umbulazi</i> (Baily) var. <i>acuta</i> , nov. . . . .	241
Gen. <i>Diaziceras</i> , nov.	
10. <i>D.</i> <i>tissotiacforme</i> , nov. . . . .	245
Family PLACENTICERATIDÆ:	
Gen. <i>Placenticeras</i> , Meek.	
11. <i>P.</i> <i>subkaffrarium</i> , sp. nov. . . . .	247
Family NOSTOCERATIDÆ:	
Gen. <i>Nostoceras</i> , Hyatt.	
12. <i>N.</i> ? <i>natalense</i> , sp. nov. . . . .	248
13. <i>N.</i> ? <i>subangulatum</i> , sp. nov. . . . .	250
Gen. <i>Bostryhoceras</i> , Hyatt.	
14. <i>B.</i> ? sp. nov. . . . .	252
15. <i>B.</i> ? sp. ind. . . . .	255
Gen. <i>Diplomoceras</i> , Hyatt.	
16. <i>D.</i> ? <i>indicum</i> , Forbes sp. . . . .	256

## Family BACULITIDÆ:

Gen. <i>Baculites</i> , Lamarek . . . . .	257
17. <i>B. capensis</i> , Woods . . . . .	257
18. <i>B. sp. aff. capensis</i> , Woods . . . . .	258
19. <i>B. cf. aspero-anceps</i> , Lasswitz . . . . .	259
20. <i>B. cf. brevicosta</i> , Schlüter . . . . .	260
21. <i>B. sp. cf. sulcatus</i> , Bailly . . . . .	260
22. <i>B. bailyi</i> , Woods . . . . .	261

## B. NAUTILOIDEA:

Gen. *Eutrephoceras*, Hyatt.

23. <i>E. aff. dekeyi</i> , Morton sp. . . . .	262
24. <i>E. cf. sublaevigatum</i> (d'Orbigny) var. <i>indica</i> (Spengler) . . . . .	263

Gen. *Cymatoceras*, Hyatt.

25. <i>C. ? sp. juv. aff. valdayurensis</i> , Blanford sp. . . . .	264
--	-----

OBSERVATIONS ON THE UMKWELANE HILL FAUNA . . . . .	264
--	-----

III. THE MANUAN CREEK FAUNA . . . . .	273
---------------------------------------	-----

## DESCRIPTION OF SPECIES:

## A. ALBIAN:

I. AMMONOIDEA . . . . .	273
-------------------------	-----

## Family PHYLLOCERATIDÆ:

Gen. *Phylloceras*, Süss.

1. <i>P. velledae</i> , Michelin sp. . . . .	273
--	-----

## Family DESMOCERATIDÆ:

Gen. *Puzosia*, Bayle.

2. <i>P. cf. bhima</i> , Stoliczka sp. . . . .	274
--	-----

Gen. *Uhligella*, Jacob.

3. <i>U. ? sp. nov. aff. stoliczkae</i> , Kossmat sp. . . . .	275
---	-----

## Family DIPLOCERATIDÆ:

Gen. *Diploceras*, Hyatt.

4. <i>D. cristatum</i> , Deluc sp. . . . .	277
--	-----

5. <i>D. quadratum</i> , sp. nov. . . . .	278
---	-----

6. <i>D. sp. nov.</i> . . . . .	280
---------------------------------	-----

Gen. *Pseudophacoceras*, nov.

7. <i>P. manuanense</i> , nov. . . . .	281
--	-----

Gen. *Subschloenbachia*, nov.

8. <i>S. preostrata</i> , nov. . . . .	284
--	-----

9. <i>S. cf. trinodosa</i> , Böse sp. . . . .	285
---	-----

10. <i>S. bispinosa</i> , nov. . . . .	285
--	-----

## Family LYELLICERATIDÆ:

Gen. *Stoliczkaia*, Nennmayr.

11. <i>S. sp. ind.</i> . . . . .	286
----------------------------------	-----

## Family HAMITIDÆ:

Gen. *Torneutoceras*, Hyatt.

12. <i>T. sp. ind.</i> . . . . .	288
----------------------------------	-----

## Family ANISOCERATIDÆ:

Gen. *Anisoceras*, Pictet.

13. <i>A. sp. ind.</i> . . . . .	288
----------------------------------	-----



## Family TURRILITIDÆ:

Gen. *Turrilites*, Lamarek.

- 14.
- T. cf. gresslyi*
- , Pictet & Campiche . . . 289

## 2. NAUTILOIDEA:

Gen. *Cymatoceras*, Hyatt.

- 15.
- C. manuanense*
- , G. C. Crick sp. . . . 290

- 16.
- C. cf. manuanense*
- , G. C. Crick sp. . . . 291

- 17.
- C. cf. albense*
- , d'Orbigny sp. . . . 292

- 18.
- C. sp. ind.*
- . . . . 293

- 19.
- C. sp. nov. ? ind.*
- . . . . 293

- 20.
- C. cf. kossmati*
- , Spengler sp. . . . 294

- 21.
- C. ? cf. clementinum*
- , d'Orbigny sp. . . . 295

## B. SENONIAN:

- 22.
- Peroniceras cf. dravidicum*
- , Kossmat sp. . . 295

- 23.
- Kossmaticeras (Madrasites) bhavani*
- , Stoliczka
- 
- sp. . . . . 299

- 24.
- Placentoceras cf. subkaffrarium*
- , sp. nov. . . 300

- 25.
- Cymatoceras ? sp. cf. justum*
- , Blanford sp. . 301

OBSERVATIONS ON THE MANUAN CREEK FAUNA . . . 302

## IV. AMMONOIDEA FROM ISOLATED LOCALITIES . . . 307

## A. NORTH-WEST SHORE OF FALSE BAY (SENONIAN).

- 1.
- Mortoniceras vanuxemi*
- , Morton sp. . . . 308

- 2.
- Bostrychoceras ? sp.*
- . . . . 308

## B. POWELL'S CAMP, UPPER CATEMBE (APTIAN) . . . 309

- 1.
- Aconeceras nisoides*
- , Sarasin sp. . . . 311

- 2.
- Cheloniceras gottschei*
- , Kilian sp. . . . 312

- 3.
- Cheloniceras (Acanthoplites ?) delagoense*
- , Krenkel sp. . 316

## I. INTRODUCTION.

THE Cephalopoda that form the subject of the present paper were included in a collection of Cretaceous fossils, sent by the Director of the South African Museum, Cape Town, and the writer is greatly indebted to Mr. Henry Woods, F.R.S., for entrusting him with the study and description of these Cephalopoda. They comprise some eighty specimens, and their study has proved of the greatest interest. Aptian fossils are described from a new locality in South Africa, and, of the later forms, some are quite new to science, whereas others have not before been recorded from this continent. It may suffice to point out here that, *e. g.*, a near ally of "*Schloenbachia acuto-carinata* (Shumard) var. *multijida*," Steinmann, *i. e.* of a group hitherto recorded chiefly from localities in North and South America, is represented in this collection. But the main interest of the collection lies in the demonstration of the occurrence, together, at some of the previously known fossil localities of Zululand, of deposits of varying dates, hitherto confused on account of similarity of matrix.

Some time ago, when re-examining Mr. Crick's types of Zululand Cephalopoda, in connection with the description of an Albian fauna from Angola,\* it became clear to the writer that the collection from the South Branch of the Manuan Creek included Albian Ammonites. Mr. Crick† had considered that they "most probably represented a somewhat higher horizon (possibly Senonian) than that indicated by the False Bay fossils." which latter were regarded to be Cenomanian. Since Etheridge‡ already had described a *Douvilleiceras* and a *Lyellicer*?§ from the neighbouring Umsinene River, and since Mr. Crick|| himself recorded, from the Middle Branch of the Manuan Creek, two undoubted Gault Ammonites, namely "*Hysterocheras*" [*Braucocheras*] sp. and "*Schloenbachia*" [*Dipoloceras*] sp., the presence of the Albian, at the South Branch also, was to be expected. In fact Mr. Crick identified four examples from this South Branch as ?*Beudanticeras beudanti*, *Anisoceras* sp., *Douvilleiceras* sp., and as "*Schloenbachia*" aff. *delaruei*, d'Orbigny sp.; the latter, a typical *Dipoloceras* of the *cristatum*-group (*s.l.*) was worked out of the matrix of one of the large *Cymatoceras* (referred to on p. 244) by Mr. Crick. But probably, on the one hand, Mr. Crick was doubtful about his identifications, for he did not mention these four important specimens in his paper; on the other hand, he may have been reluctant to assume different horizons for what appeared to be the fauna of one single formation. The Albian, Cenomanian and Senonian Ammonites may be preserved in a very similar brownish, friable matrix, and since there were as many Senonian as Albian forms (in addition to one Cenomanian *Acanthoceras*) present in the fauna from the South Branch, Mr. Crick described the whole as "possibly Senonian."

In a later paper, Mr. Crick¶ stated that the occurrence (in the Manuan Creek district) of Cretaceous beds of an age younger than Cenomanian was somewhat doubtful. On the other hand, Mr. R. B. Newton, in his paper on "The Cretaceous Gastropoda and Pelecypoda from Zululand,"\*\* discusses the evidence in favour of a Senonian

\* Read before the Royal Society of Edinburgh, December 6th, 1920. (See 'Nature,' vol. cvi. No. 2669, December 23, 1920, pp. 554-5.)

† "Cretaceous Fossils of Natal," pt. iii, No. 2: "The Cephalopoda from the Tributaries of the Manuan Creek, Zululand," 'Third Rep. Geol. Surv. Nat. and Zulul.,' 1907, p. 249.

‡ *Ibid.*, pt. ii, "The Umsinene River Deposit," p. 87.

§ *Gen. nov.* (type, *A. lyelli*, Desh. in Leym.; d'Orbigny, 'Pal. Franç. Ter. Crét.,' pl. lxxiv, figs. 1 and 2) dealt with in the writer's Angola paper.

|| *Loc. cit.*, pp. 247-8.

¶ "Cretaceous Rocks of Natal and Zululand," 'Geol. Mag.,' n.s., dec. v, vol. iv (1907), p. 347.

\*\* 'Trans. Roy. Soc. S. A.,' vol. i, pt. i (1909), pp. 94-5.

horizon for the Manuan Creek Fauna, and though he points out that "several of the species bear a distinctly older appearance," he goes on to say: "Taking into consideration . . . that there is no great difference in the lithological character of the matrix accompanying the various specimens from the Manuan Creek, it would seem that we are dealing with a fauna of one geological age which may be regarded as Emscherian or Lower Senonian, since it includes *Veniella forbesiana*, a characteristic pelecypod of the Upper Trichinopoly beds of Southern India . . ."

The Ammonites of the present collection include a number of typical forms that confirm the presence, at some of the localities, of deposits of various geological ages. The collection includes:

(a) A typical Albian fauna from "Manuan Creek" and the "Middle Branch, Manuan Creek" (19 specimens).

(b) Albian and Senonian Ammonitids from the "south side of Manuan Creek Valley," from "high ground on north side of United Manuan Creek and Umsinene River, almost opposite junction"; and from "Low Ridge about 3 m. east of foot of Lebombo Mountains, north of MKusi River, due east of Ubombo" (10 specimens).

(c) Senonian examples from the "North-West Shore of False Bay" (2 specimens).

(d) Aptian Ammonites from Powell's Camp, Upper Catembe (3 specimens).

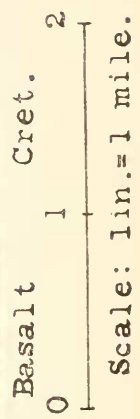
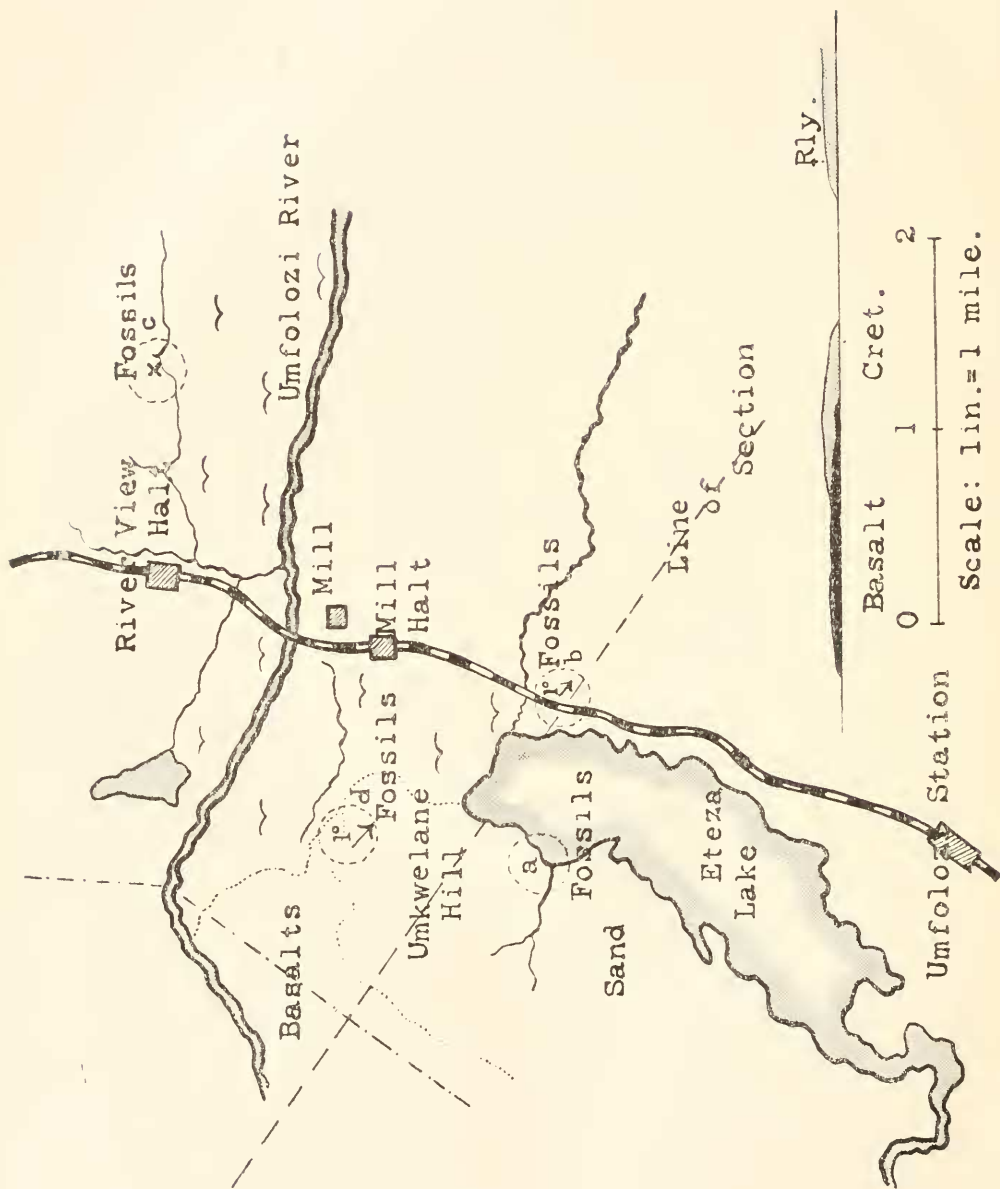
(e) A Senonian fauna from Umkwelane Hill. This includes over forty specimens (half of which number are *Baculites*), mainly from Umkwelane Hill itself (= *d* on the accompanying sketch-map), but comprising a few examples from the three neighbouring localities: Lake Itesa (Eteza) (= *a* on map), the railway cutting (= *b* on map), and the Umfolozi Valley, east of railway (= *c* on map). This fauna, first made known by Etheridge,\* probably corresponds in age with the Pondoland fauna described by Woods.†

The following note by Dr. A. L. du Toit, dated March 20th, 1920, describes the nature of the deposits:

"At Umkwelane Hill, the Cretaceous rests directly upon Stormberg basalts (Liassic ?), the strata being hard shelly limestones and softer buff-coloured sandstones and other softer beds, rarely exposed; pebbles of older formations are found occasionally in them. The first fossiliferous limestone comes in a few feet from the base. These bands

\* "Cretaceous Fossils of Natal," pt. i: "The Umkwelane Hill Deposit, Zululand." 'Second Report Geol. Surv. Nat. and Zulul.,' 1904, pp. 69-93, pls. i-iii.

† "The Cretaceous Fauna of Pondoland," 'Ann. S. Afr. Mus.,' vol. iv, pt. vii, No. 12 (1906).



are intensely hard and are crowded with lamellibranchs, etc., much broken shelly matter, but the fossils are difficult to extract.

“Along the railway cutting, the section shows dark-brown to khaki-coloured sandy stuff, without good bedding, with thin sandstone-ribs and concretionary limestone-nodules, in which Ammonites are found. Apparently, the same horizon is represented N. of the Umfolozi River at point X (see plan), where Ammonites are common. . . . The whole thickness of strata involved is probably not more than 250 feet, the dip being S.E. at  $1^{\circ}$  or  $1\frac{1}{2}^{\circ}$ ; and since the strata must have accumulated in shallow water, it is unlikely that several distinct zones are represented, all the fossils may therefore be considered to come from one horizon, and the beds and their fauna can therefore be regarded as a whole.”

It will be advisable to describe the Umkwelane Hill fauna separately from that of the Manuan Creek and the other localities. There is a large collection of Ammonites from the Umzamba (“Umtamvuna”) Beds of Pondoland in the British Museum, approximately corresponding in age with the Umkwelane Hill fauna, as stated by Woods\* and by Crick† in his very useful general account of the “Cretaceous Rocks of Natal and Zululand.” Crick was at work describing this fauna already before 1906‡ but his MS. is still unfinished, and the writer hopes to complete and revise it as soon as facilities for publication are offered. This collection in the British Museum includes a number of species not known to Baily, Griesbach, Woods and Van Hoepen, and not represented at Umkwelane Hill; and reference to some of these will be made in the specific descriptions when necessary. A new collection of Pondoland Ammonites, kindly sent to the writer by Mr. Henry Woods, includes a further series of undescribed forms. In his account of this fauna, to be published shortly in the ‘Annals of the Durban Museum,’ the writer is drawing attention to the improbability of such faunas representing only “one horizon.” The great majority, if not all, of the Pondoland and Umkwelane Hill forms are of Campanian and Maestrichtian age, a possible range of at least five zones. The Pondoland strata are only twenty feet thick and of a sandy facies, suggesting rapid deposition: but the new collection contains doubtful or long-lived species that might even be pre-Campanian in age. The assertion, thus, is not justified that the corresponding beds at Umkwelane Hill, of a much greater thickness, can be regarded as belonging to “one horizon.”

The third part of this paper will deal with the Manuan Creek

\* *Loc. cit.*, p. 347.

† *Loc. cit.* (‘Geol. Mag.’), p. 313.

‡ Woods, *loc. cit.* (1906), p. 337. Kossmat, “Die Bedeutung d. Südind.-Kreideform.,” ‘Jb. K.K. Geol. R.A.’, vol. xlv (1894), Heft 3 and 4 (1895), pp. 463-4

fauna; the few specimens from isolated localities, namely (*c*) and (*d*) above, are described separately under IV.

By the kindness of Dr. A. Smith-Woodward and Dr. F. A. Bather, of the British Museum, the writer has been able to make the fullest possible use, for comparison, of the rich collections under their charge. Similar facilities were accorded him by Prof. W. J. Sollas, Mr. C. J. Bayzand, and Mr. J. A. Douglas, at the Oxford University Museum; by Prof. A. M. Davies at the Imperial College of Science; by Dr. F. L. Kitchin at the Museum of Practical Geology. To all these gentlemen, and especially to Mr. Henry Woods, of the Sedgwick Museum, Cambridge, the writer expresses his cordial thanks.

## II. THE UMKWELANE HILL FAUNA.

### DESCRIPTION OF SPECIES.

#### A. AMMONOIDEA.

##### FAMILY: DESMOCERATIDÆ:

##### GEN. PARAPUZOSIA, Nowak.

##### 1. PARAPUZOSIA sp. nov. ? ind.

(Pl. XIX, fig. 2; Pl. XX, figs. 1, 1*a*; Pl. XXIV, fig. 3.)

? 1906. *Desmoceras* (*Puzosia*) *gaudama* (Forbes) Boule, Lemoine & Thévenin, "Pal. de Madagascar," III, "Céphal. Crét. Diego-Suarez." Ann. de Pal., vol. i, fasc. iv, p. 20, pl. iv, fig. 5 only.

The writer has not seen the specimen upon which this description is based; but in addition to the measurements given below and to the two photographs here reproduced, a plaster cast of a portion of the inner whorls (Pl. XXIV, fig. 3) was forwarded, the specimen itself being too bulky to be sent. The measurements, according to Mr. S. H. Haughton's note, accompanying the photographs, are as follows:

Diameter	. . . . .	670 mm.
Height of last whorl	. . . . .	325 [= 48·5 per cent. of the diameter].
Thickness	„ „ . . . . .	225 [= 33 „ „ „ „ ].
Umbilicus	. . . . .	120 [= 18 „ „ „ „ ].

The specimen was also characterised as "looking very similar to one or other of the species of *Desmoceras* (*Puzosia*) described from Madagascar"; and since the inner whorls, according to the plaster cast of the dorsal impression, show the ribbing and compressed aspect of *P. gaudama*, Boule, Lemoine and Thévenin\* *non* Forbes, the

\* *Loc. cit.*, fig. 4*a* of pl. iv, which, however, is more compressed.



specimen is compared with the gigantic Ammonite cited above, and by these authors doubtfully classed with Forbes' species, and with the smaller figured example. The suture-line seems to agree very well, judging from the photographs only; but the bulges on the inner portions of the lateral area, reminiscent at once of *Parapuzosia leptophylla* (Sharpe) and of certain *Pachydiscus* and *Parapachydiscus*, are not apparent in the photographs of the form here described. *P. gandama* itself (B.M. Geol. Soc. Coll. 10487) is different, and *P. corbarica*, Grossouvre,\* with a thickness of only 27 per cent. of the diameter, is too compressed. The ornament of the inner whorls of the example here described, however, is very similar to that of this species, as it also is to that of the more coarsely ribbed *P. daubrœi*, Grossouvre sp.,† though, owing to the absence of the inner half of the lateral areas, the primary costæ are only just indicated, so that comparison with this species, the presumed genotype, is difficult. The sectional outline of Grossouvre's species given by Nowak‡ is more compressed than that of the Zululand form. On the other hand Nowak's figure of the suture line § apparently shows good agreement, as does that of *P. leptophylla*, Sharpe sp.|| The fine example of *P. daubrœi* figured by Müller and Wollemann¶ has a larger umbilicus and very strong primary costation.

Nowak is inclined to unite these two Santonian species, and considers *P. tannenbergieu*, Fritsch and Schloenbach\*\* to be closely related, but he also quotes, as an example of *Parapuzosia*, Stoliczka's *A. denisonianns*, which is pre-Senonian, like *P. austini*, Sharpe sp.,†† a form much nearer the ancestral *Puzosia*-type. *P. stobae* Nilsson,‡‡

\* "Rech. s. l. Craie Sup.," H., Pal., "Les Amm. d. l. Craie Sup." 'Mem. Carte Géol. France,' 1893 (1894), p. 174, pl. xxvii, figs. 1 a, b.

† *Ibid.*, p. 154, pl. xxviii. ("Sonneratia," in Grossouvre.)

‡ "Unters. ü. d. Ceph. d. Ob. Kreide Pol.," iii, 'Bull. Ac. Sci. Cracovie ser. B (1913), pl. xliii, fig. 32, p. 363.

§ *Ibid.*, pl. xliv, fig. 40.

|| 'Moll. Chalk England,' III, "Cephal." (1856), pl. xxi, fig. 2.

¶ 'Moll. Fauna d. Unter-Senon v. Braunschweig,' II, "Ceph.," 'Abh. Preuss. L.A.,' N.F., Heft 47 (1906), p. 8, pl. v.

\*\* 'Cephal. d. Böhm. Kreideform.,' Prague, 1872, pl. ix.

†† *Loc. cit.*, II, 1854, p. 28, pl. xii, figs. 1 a, b.

‡‡ 'Petrif. Suec. form. cret.,' p. i, London, 1827, p. 5, pl. i. Moberg, 'Ceph. i Sverig. Kritsyst.,' II, "Artbeskrifn.," Sver. Geol. Unders., ser. C, No. 73, 1885, p. 18, pl. ii, figs. 1-5. Nilsson's figure is somewhat diagrammatic, but Moberg's example (1 a) represents a form apparently similar to the specimen here described, if more compressed. The suture-line, however, stamps *P. stobae* to be a *Parapachydiscus*, connected with such forms as *P. colligatus* by *P. exilis*, Binkhorst, which Schlüter (*loc. cit.*, p. 56) thought perhaps belonged to *P. stobae*.

which is a pachydiscoid development (*Parapachydiscus*) later than *P. denisoniana*, and which has *Puzosia*-like inner whorls, is also grouped here by Nowak. But the forms that continue the *Puzosia*-type into the Senonian (*P. gaudana*, Forbes, *P. iudopacifica*, Kossmat, etc.), and once more produce transitional forms to *Kossmaticeras* (*P. darwini*, Philippi in Steinmann), cannot be classed in the same genus with *P. denisoniana* which developed a "*Pachydiscus*-stage" already in the Turonian.\*

The inclusion of the Zululand example in this polyphyletic genus, then, is only provisional, and based on the assumption that *P. daubrœi* is the genotype of *Parapuzosia*. The ornamentation of the inner whorls shows that it is not a *Parapachydiscus*; and the writer believes that it has nothing to do with the gigantic forms of the type of *P. seppuradeusis*, Landois,† which Nowak,‡ in the writer's opinion wrongly, also considers possibly to belong to *Parapuzosia*.

*Locality*.—Railway cutting, Umfolozi. Coll. Dr. A. L. du Toit. S.A.M. Cat. No. 5513.

#### GEN. PARAPACHYDISCUS, Hyatt.

##### 2. PARAPACHYDISCUS sp. nov. aff. COLLIGATUS, Binkhorst sp. § (Pl. XXII, figs. 1 a, b.)

1861. *Ammonites colligatus*, Binkhorst. Mon. d. Gast. & Céph. de la Craie Sup. d. Limbourg, ii, p. 25, pl. viii a only.

1894. *Pachydiscus colligatus*, de Grossouvre. Ann. Craie Supér., p. 202.

1908. *Pachydiscus colligatus*, de Grossouvre. Descr. d. Amm. d. Crét. Sup. du Limbourg, etc. Mém. Mus. Roy. d'Hist. Nat. Belg., vol. iv (1908), p. 28, pls. iv–viii.

\* Forbes ('Trans.,' 2nd ser., vol. vii, 1846, p. 114) stated that there was a "fragment of a very large Ammonite, but undeterminable, among the specimens from Trichinopoly." This example, now in the British Museum (Geol. Soc. Coll.), probably belonged to a form of this group of "*Puzosia*," but consists of one camera only (H. = 170 mm. and Th. just a little less). The extremely complex lateral lobe and short siphonal lobe are like those in *P. denisoniana*, as figured by Kossmat (*loc. cit.*, pl. xiv, fig. 6), but there is no ornamentation remaining at this pachydiscoid stage.

† "Die Riesen-Amm. v. Seppurade," 23. Jahresb., 'Zool. Sect., Westfäl. Prov.-Ver. f. Wiss. and K.' (1895), pp. 99–108, pls. i and ii.

‡ *Loc. cit.* (1913), p. 365.

§ Kossmat (*loc. cit.*, p. 166 [101]) considered the two species, *colligatus* and *atocodensis*, to be closely allied, but the latter is quite different, judging by Kossmat's own identifications in the British Museum collections.



1913. *Pachydiscus colligatus*, Nowak. Unters. Cephal. ob. Kreide Polen, iii, Bull. Ac. Sci. Cracovie, ser. B, p. 361, pl. xliii, fig. 30, pl. xlv, fig. 39.

A completely septate specimen (No. 5489) of 145 mm. diameter has an umbilicus of about 20 per cent. of the diameter and a whorl thickness of about 60 per cent. The ribbing is obscure, the example being only an internal cast; but there are about 25 costae on the outer whorl, weakened at the grooved siphonal line and with a slight forward sinus. Some of these costae do not reach to the rounded umbilical border; those that do are not distinctly tuberculate, and the inner whorls, as shown in the deep umbilicus, are almost unornamented. There are only nine septa on the last whorl, but these attain an extreme degree of complication, equalled, perhaps, only by such forms of *Parapachydiscus* as *P. quiriquinae* (Philippi), Steinmann sp.

The specimen shows close resemblance with the examples figured by Binkhorst on pl. viii *a*, and which were selected as typical by Grossouvre, though Pervinquière\* was of opinion that the large form figured by Binkhorst on pl. viii, and which was renamed *P. van den broeckii*, should be taken as type of Binkhorst's species. †

The present example differs from the typical *P. colligatus* (pl. iv, fig. 3, and pl. v, fig. 1, in Grossouvre) only in having, at a radius of 75 mm., a thickness of 75 mm., not 52 mm. as given by Grossouvre: in other words it retains the globosity of the inner whorls of *P. colligatus* to a larger diameter. The costation, possibly, also is a little too distant in the Zululand example.

One of Schlüter's ‡ examples of *Parapachydiscus wittekindi* has this more distant costation and thick whorls, but judging by a number of Westphalian examples of this species in the British Museum, the wide and strongly costate umbilicus separates Schlüter's species from the form here described.

*Parapachydiscus ? portlocki*, Sharpe sp., § similarly differs from the latter in having a wider umbilicus, surrounded by tubercles. In whorl-shape, however (thickness = 60 per cent. of the diameter), the

\* "Ét. de Pal. Tunis," I, "Céph. d. Ter. Sec.," Carte Géol. d. l. Tunisie (1907), p. 175 (footnote).

† This "species" was withdrawn in 1908 by A. de Grossouvre, who then figured Binkhorst's original (in the Berlin Museum)—a poorly preserved example.

‡ "Ceph. d. Ob. Deutsch. Kreide.," I, Palaeontogr., vol. xxi (1872), e. g. example 2 of p. 68 (*A. robustus*), with thickness = 57 per cent. of the diameter, pl. xxi, figs. 5 and 6; pt. ii (1876), p. 160. Boule, Lemoine and Thévenin (*loc. cit.*, II, 1907, p. 22) wrongly consider this species of *Parapachydiscus* to be the type of *Pachydiscus*, Zittel.

§ "The Fossil . . . Mollusca . . . Chalk of England," II, "Ceph.," Pal. Soc. Mon., 1854, p. 30, pl. xiii, figs. 2, 3.

two forms are closely comparable, though the adult *portlocki* develops ventral tuberculation.

*P. epiplectus*, Redtenbacher,\* included by Grossouvre and Nowak in the synonymy of *P. colligatus*, differs both from the latter and from the present example in the pronounced peripheral sinus in the costation.

*P. quiriquinae* (Philippi), Steinmann sp.† resembles the Zululand example in suture-line, and has a similar straight principal lobe, but is too thin and too closely costate.

"*A. newberryanus*," Meek sp., as figured by Gabb has a similar suture-line, but the costation is finer and closer, and the whorl-section is more compressed than in the specimen under description. On the other hand, Whiteaves‡ figures as *A. newberryanus*, Meek, an Ammonite which, judging by comparable examples from Vancouver Island in the British Museum,|| belongs to a group of forms quite different from the *Parapachydiscus* here discussed and related to the *isculensis*-group of Nowak and to *Kossmaticeras*. Of Japanese forms, *P. teshionensis*, Jimbo,¶ is less globose and less involute than the African example; it also has umbilical tubercles and a less complex suture-line. *P. naumanni*, Yokoyama,\*\* resembles the specimen here described in globosity, but has varices with close costation, and a comparatively large umbilicus.

\* "Ceph. Fauna d. Gosau-Sch.," 'Abh. K.K.R.A.,' vol. v (1873), p. 121, pl. xxviii, fig. 1.

† "Beitr. z. Geol. and Pal. S. Amer.," III, "D. Alt. und d. Fauna d. Quiriquina Sch. in Chile," N. Jb. f. Min., etc., Beil. Bd. x (1895), p. 74, pl. vi, fig. 3, Text-fig. 5 on p. 77.

‡ 'Pal. of Calif.,' vol. i (1864), p. 61, pl. xxvii, fig. 199, and pl. xxviii, fig. 199a. Whiteaves ('Mesoz. Foss.,' p. 107), included this form in *A. complexus* var. *suciensis*, Meek; later (*ibid.*, p. 344) renamed *Pachydiscus suciensis*, Meek sp. (The reference is [wrongly] to *A. brewerianus*, Gabb, in both cases.) Three examples, doubtfully referred to *Pachydiscus complexus*, var. *suciensis*, by Kossmat, from Vancouver Island in the British Museum Collection, are quite different from the Californian Ammonite, which also is quite different from Meek's original *A. complexus*?, var. *suciensis* ('U.S. Geol. and Geogr. Surv.,' Bull. No. II, 1876, p. 369, pl. v, fig. 2).

§ 'Mesoz. Foss.,' I, pt. ii. "Foss. Cret. Rocks Vancouver, etc.," 'Geol. Surv. Can.,' 1879, p. 109, pl. xiv, figs. 1 and 1a.

|| Associated with *P. otacodensis*, Stoliczka (Whiteaves, *loc. cit.*, I, V, 1903, p. 340, pl. xlvi, fig. 1, and 'Trans. Roy. Soc. Can.,' 2nd ser., vol. i, sect. iv, 1895 [1896], p. 131), and other species of *Parapachydiscus* labelled by Kossmat (see 'Jb. K.K. Geol. R.A.,' vol. xlv [1894], p. 472).

¶ "Beitr. z. Kemtu. d. Fauna d. Kreidef. v. Hokkaido," 'Paläontol. Abh. Dames & Kayser,' vol. vi, pt. iii (1894), p. 30 (176), pl. iii, fig. 1.

\*\* "Verstein. a. d. Japan Kreide," 'Paläontograph.,' vol. xxxvi (1890), p. 187, pl. xxii, fig. 1.

*P. arrialoorensis*, Stoliczka,\* is very close to the Zululand example in shape, umbilicus and number of costae but differs in the character of the periphery, unless this difference, well seen on comparing fig. 1 c of Grossouvre's pl. v with fig. 3 a of Stoliczka's pl. lxiii, is due to the presence of the shell in the Indian form, which seems doubtful in view of its sandy matrix. However, the larger and somewhat different example figured by Yokoyama† shows distinct and sinuous costation on the ventral area both of the cast and of the shell. The suture-line of the Indian species also is simpler than that of the example here described.

*P. colligatus* has been recorded from Tullear, on the West Coast of Madagascar, and other species of "*Pachydiscus*," including *Jacobites* from other parts of the island.‡ Woods stated§ that *Pachydiscus* was absent in Pondoland; but there are four specimens from the Umtamvuna River in the British Museum,|| including two large examples that may belong to forms of the *colligatus*-group. The presence of "*Pachydiscus*" both in Pondoland and in Zululand thus forms a further point of resemblance with the Indo-Malgasian fauna.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

### 3. PARAPACHYDISCUS cf. WITTEKINDI, Schlüter, sp.

(Pl. XXIV, fig. 1.)

1872. *Am. robustus*, Schlüter, "Ceph. d. Ob. Deutsch. Kreide," Palaeontogr., vol. xxi, p. 67, pl. xxi, figs. 5 and 6, pl. xxii, figs. 1-3.

1876. *Am. wittekindi*, Schlüter (*ibid.*), vol. xxiv, p. 40 (160).

\* In Blanford and Stoliczka, "Foss. Ceph., Cret. Rocks of S. India," 'Mem. Geol. Surv., India, Pal. Indica' (1865), p. 126, pl. lxiii, fig. 3 only.

† *Loc. cit.* (1890), i, p. 186, pl. xxi.

‡ See Boule and Thévenin, 'Bull. Soc. Géol. France,' ser. iv, vol. iii, 1903, p. 436; Boule, Lemoine and Thévenin, *loc. cit.* (1907), pp. 23-25; Kilian and Reboul: "Les Céph. Néocret. d. Îles Seymour et Snow-Hill," 'Wiss. Erg. Schwed. S. Pol. Exp. 1901-03,' III, 6 (1909), p. 25.

§ *Loc. cit.* (1906), p. 346.

|| Two of these, named *P. umtamuensis* by Crick (MS.), Nos. C19434-5, and compared with *P. tweenianus*, Stoliczka (*loc. cit.*, 1865, p. 107, pl. lv only), one of the species found in Madagascar, are evolute, like *P. conduciensis*, Choffat, and with comparatively simple suture-line, thus differing from the typical *Parapachydiscus*. They are similar to certain South-American "*Pachydiscus*" (Paulcke "Die Ceph. d. Ob. Kreide Südpatagoniens," 'Ber. Naturf. Ges. Freiburg i. B.,' vol. xv (1907), e. g. pl. xix [x]). The other two gigantic specimens, not described by Crick, may belong to *Parapachydiscus* of the *colligatus-supremus* type, but one has an umbilicus of 19 per cent. and a thickness of 45 per cent. of the diameter, the other at a whorl-height of 260 mm. a thickness of 200 mm.; both are more compressed than the Zululand specimens here described, and intermediate in sectional outline between figs. 30 (*P. colligatus*) and 31 (*P. oldhami*) in Nowak (*loc. cit.*, 1913, pl. xliii).

A gigantic example (No. 3969) resembles the form last described, but has a wider umbilicus. Its dimensions are :

Diameter	. . . . .	390 mm.
Height of the last whorl.	. . . . .	46 per cent. of the diameter.
Thickness .. .. .	. . . . .	49 .. .. .
Umbilicus . . . . .	. . . . .	25 .. .. .

The costation disappears on the ventral area and remains distinct on the inner half of the side, which is just the reverse of what takes place in *P. supremus*, Pethö sp.,\* included in the synonymy of *P. colligatus*, Binkhorst sp., by Grossouvre and Nowak.† *P. fresvillensis*, Seunes,‡ and *P. epilectus*, Redtenbacher,§ show a similar change, but one of the examples of the former species, figured by Seunes (pl. xii (iii), fig. 1), agrees with the specimen here described in having a somewhat reniform whorl-section, with the greatest thickness near the umbilical border. The latter character distinguishes the Zululand example from *P. teshionensis*, Jimbo,|| which apparently weakens the ornament of the periphery and retains the principal lateral costae after the manner of *P. egertonianus* (Forbes), Stoliczka sp.,¶ which latter species, however, is far too compressed.

*P. harudai*, Jimbo,\*\* and the larger example referred to the same species by Whiteaves,†† have more compressed whorls at a stage when the present form is still very depressed. It is also doubtful whether large examples of this species would develop the secondary ornamentation of the typical forms of this group. This equally applies to the evolute *P. steinmanni*, Paulcke,‡‡ that may or may not develop these obscure bulges at a large diameter, but resembles the form here described in the roundness of the inner whorls.

Schlüter's *A. wittekindi* differs from the form here described in whorl-section, though the inner whorls of the South African form apparently are more depressed than is its outer whorl. The Westphalian form also appears to lose its first costation at an earlier stage,

\* "Kreidefauna d. Peterwardeiner Geb.," 'Palaeontogr.,' vol. lii (1906), p. 88, pl. v, fig. 1.

† *Loc. cit.* (1908), p. 29 and (1913) p. 361.

‡ "Contrib. à l'Ét. d. Céphal. Crét. Sup. France," 'Mem. Soc. Géol. Fr.,' Pal., vol. ii, fasc. iii (1891), p. 3, pl. i, fig. 1.

§ *Loc. cit.*, p. 121, pl. xxviii, fig. 1.

|| *Loc. cit.* (1894), p. 30 (176), pl. iii, fig. 1.

¶ *Loc. cit.* (1865), p. 104, pl. liii, fig. 1.

\*\* *Loc. cit.* (1894), p. 29, pl. ii, fig. 2.

†† "Vancouver Cret. Foss.," 'Trans. Roy. Soc. Can.,' 2nd ser., vol. i (1895), sect. iv, 1896, p. 132, pl. iii, fig. 6.

‡‡ *Loc. cit.* (1907), p. 230 (64), pl. xviii (ix), fig. 1.

and the costae of the secondary ornament (if the large and thin examples belong to the same species) are too pronounced on the venter. *P. seppenradensis*, Landois,\* which was compared with *P. wittekindi* (and *Pachydiscus lewisiensis*) by Zittel, retains its costation to a very large diameter, but apparently belongs to the true *Pachydiscus* of the *perampus* group, with comparatively simple suture-line.

*P. leryi*, Grossouvre sp.,† probably is a close ally of the Zululand form, but has pronounced umbilical tubercles instead of mere swellings of the primary ribs, as indicated in Schlüter's fig. 5 of pl. xxi.

The large forms of *Parapachydiscus* from Pondoland, referred to under *P. sp. nov. cf. colligatus*, are more compressed than the present example.

The suture-line of *P. wittekindi* is less complex than that of the Zululand form, which resembles in this respect the suture-line of *P. quiriquinae* (Philippi), Steinmann sp.,‡ especially in the straight line formed by the main stem of the principal lobe. The distance of this line from the parallel siphonal line is 95 mm. There is a slight groove on the periphery, marking the position of the siphuncle, as in *P. colligatus*.

The comparison of this species with *P. wittekindi* cannot be taken to indicate affinity with the European fauna, for they certainly are not specifically identical, and the present form is attached to Schlüter's species only because of Indo-Pacific species, that may be more nearly related, corresponding large stages are unknown, so that comparison is difficult.

*Locality*.—Umfolozi River, East of Railway. Coll. Mr. Illingworth.

#### 4. PARAPACHYDISCUS, sp. ind.

Portions of a gigantic specimen (4985), at least half as large again as the example last described, and therefore probably of a diameter of about 600 mm., differ slightly from this other large specimen (No. 3969) in the suture-line. Only the peripheral portions of two camerae, including the greater part of the external saddles, are preserved; the median saddle in the ventral lobe alone is 46 mm. wide. The details of the ventral lobe differ somewhat from those shown in the peripheral aspect of *P. colligatus*, Binkhorst in Grossouvre§ (with which the small example (No. 5489) shows good agreement).

\* "Die Riesen-Amm. v. Seppenrade," 23. Jahresb., 'Westfäl. Prov.-Ver. f. Wiss. and Kunst.', 1895, p. 104, pls. i and ii.

† *Loc. cit.* (1894), p. 178, pl. xxi.

‡ *Loc. cit.* (1895), text-fig. 5, p. 77.

§ *Loc. cit.* (1908), pl. vi, fig. 1a.

The shell is partly preserved and 3 mm. thick in places, but less than 2 mm. in others. It is in two thick layers, fibrous and of a white porcellanous aspect, like certain *Inoceramus* shells in the chalk, with a thin inner and outer coating. The specimen may belong to a fat form of *Parapachydiscus*, like the two examples previously described, but is too incomplete for specific determination. The large *Parapachydiscus* from Pondoland are far more compressed.

*Locality*.—Lake Itesa (Eteza), Umfolozi. Coll. W. J. Wybergh.

## FAMILY: PRIONOTROPIDÆ.

### GEN. MORTONICERAS, Meek.

#### 5. MORTONICERAS WOODSI, sp. nov.

(Pl. XXI, figs. 1 *a-d*.)

The single specimen (No. 5451) upon which this species is based has the following dimensions:

Diameter . . . . .	80 mm.
Height of the last whorl . . . . .	45 per cent. of the diameter.
Thickness " " . . . . .	40 " " "
Umbilicus . . . . .	? 25 " " "

The important characteristics of this new species are (1) the decline of lateral and peripheral ornament on the last whorl, which is still septate, so that the specimen represents the inner whorls of an Ammonite that appears to lose altogether the typical *Mortoniceras* features; (2) the projection of the tubercle at the overhanging umbilical edge in an inward, not a lateral direction; (3) a comparatively small umbilicus.

Among a large number of *Mortoniceras* of the type of *M. soutou* (Baily)\* from the Umtamvuna River, in the British Museum, there are some transitional forms to the present species, showing decline of tuberculation on the outer whorl (at a considerably larger diameter) and a decrease in the size of the umbilicus. On the other hand, one of the forms figured by Stuart Weller† as *Mortoniceras delawarensis*,

\* The example figured by Woods (*loc. cit.*, 1906, p. 337, pl. xliii, fig. 1) represents a more evolute shell. Baily's type in the British Museum (Geol. Soc. Colln. No. 11365) has the decline of tuberculation more pronounced, but at a diameter of close on half a metre is still costate. Its small umbilicus brings it closer to the new species here described than is Woods' more evolute example.

† "Report on Cret. Pal. of New Jersey," vol. iv (Pal. Ser.), 'Geol. Surv. of New Jersey,' 1907, p. 837, pl. civ, figs. 1-3 only. (See under *Mortoniceras Vanuxemi*, Morton sp., p. 308.)



Morton sp., is considerably closer to the present species, as is one of the specimens figured by Whitfield,\* which latter example, however, is of a considerably larger size. These forms of the *delawarensis*-group, however, neither have the overhanging umbilical edge, nor the close costation of the present species, though they are nearer to the latter than is any other of the very numerous species of *Mortoniceras* described.

Pervinquier† doubtfully recorded *M. delawarensis* (with varieties) from Tunis, but his specimens are much more strongly tuberculate than the new form here described and thus resemble *M. campaniense*, Grossouvre, which species subsequently was united by its author with *M. delawarensis*.

One characteristic feature of these forms of the *delawarensis* group is the weakening of the wide and low keel, carried to extremes in the fragment figured as *M. delawarensis* by Julia A. Gardner.‡ It is difficult, from an inspection of the figure, to form an opinion as to the exact relationship of this form, for it has an almost flat, *Hoplites*-like ventral area. At any rate, its convergence towards such a form as the Upper Campanian *A. marroti* (Coquand), Grossouvre,§ is striking.

None of the species of *Mortoniceras* from the European Senonian resemble the form here described. The suture-lines of Grossouvre's Coniacian species are considerably simpler than are those of the Campanian *delawarensis*-group. It has been possible to develop the internal portion of the suture-line of the present species, and a comparison with that of *M. texanum* (Römer) as figured by Schlüter|| is interesting as showing not only great increase in complication, but accommodation to a different whorl-shape. The suture-line of an

\* "Gast. and Ceph. of the Raritan Clays, etc.," 'Mon. U.S. Geol. Surv.,' vol. xviii (1892), p. 252, pl. xliii, figs. 1, 2 only.

† "Études de Pal. Tunis," I, 'Céph. d. Ter. Second,' 1907, p. 243, pl. xi, figs. 21 and 22. Pervinquier, in his note (1) on p. 244, somewhat misrepresents Whitfield, for the remark in the latter author's description of *M. vanuxemi* (p. 254) refers to the compressed specimen he figures (pl. xlii, figs. 3 and 4), not to Morton's type. The latter is somewhat doubtful. It would be advisable to take as type of *M. delawarensis*, Morton sp., figs. 6 and 7 in Whitfield, and as type of *M. vanuxemi* (Morton em. Whitfield), figs. 3 and 4 of the same plate (xlii) in Whitfield. Stuart Weller (*loc. cit.*, p. 839) unites the two species again—in the writer's opinion unjustly.

‡ "Up. Cret. Dep. of Maryland," 'Maryland Geol. Surv. Baltimore,' 1916, p. 391, pl. xii, fig. 7.

§ *Hoplites vari*, Schlüter var. *marroti* in Grossouvre, *loc. cit.* (1894), p. 119, pl. viii, fig. 3 b = *Hoplitoplacenticeras*, Paulcke.

|| "Cephal. d. Ob. Deutsch. Kreide," 'Palæontogr.,' vol. xxi, part 2 (1872), p. 41, pl. xii, fig. 3.

example of *M. soutoni* (Baily), very close to Baily's type, with small umbilicus, but comparatively smooth outer whorl (B.M. No. C19441, after G. C. Crick), also is given for comparison (Plate XX, fig. 4), since it differs considerably from that figured by Woods and from the original (faulty) drawing in Baily.

*Locality*.—Umkwelane Hill, Umfolozi. Coll. Dr. A. L. du Toit.

6. *MORTONICERAS* aff. *UMKWELANENSE*, G. C. Crick.

(Text-fig. D 2, p. 297.)

1907. *M. umkwelauense*, G. C. Crick, *loc. cit.* (Third Report), p. 228, pl. xv, figs. 9, 9 a.

Crick briefly characterised this species, which he considered to be related to *M. soutoni* and *M. stangeri*, as having a "subquadrate transverse section, a little wider than high." The example to be described (No. 5491) differs from the holotype (B.M. No. C18134) in several respects, but in view of the great variability of the nearly related *M. soutoni*, of which a large number is available, it is considered inadvisable to separate the present example from the specimen figured by Crick. The dimensions of the specimen in the present collection are:

Diameter . . . . .	250 mm.
Whorl height . . . . .	82 ..
Whorl thickness . . . . .	69 ..

At a diameter of 160 mm. the measurements for height and thickness are 60 mm. and 62 mm. respectively; at 90 mm. diameter they are 33 mm. and 39 mm. Whereas, thus, the inner whorls are wider than high, and at a diameter of 160 mm. the whorl-height almost equals the thickness, as in the holotype, on the outer whorl the proportions are reversed and the whorl is higher than wide. It may be added that at 250 mm. diameter the specimen is still septate. Owing to the presence of an additional, if slight, tubercle on the lateral area of the specimen here described, the whorl-section is more rounded than that of the holotype, a feature still further accentuated by the removal, away from the umbilicus and higher up on the side, of the umbilical tubercle.

At a diameter of 90 mm. there are only fifteen coarse costae per whorl, as in the holotype. The suture-line is of the same general type as that of *M. soutoni*; the position of the umbilical tubercle, however, in the latter, corresponds with the second lateral saddle, whereas in the present example it coincides with the inner branch of the bifid first lateral saddle (compare Text-fig. D 2 with fig. 4 of Plate XX).

The presence of a fifth tubercle, smaller than the others, as it also is



in examples of *M. texanum* (Römer), makes the Ammonite here discussed somewhat of a transition between the compressed form next described and compared with *M. soutoni*, and Crick's holotype. The inner whorls, however, are different in the two developments, and there are other distinctions, as pointed out in the description below. In *M. soutoni*, as well as in *M. texanum* (Römer) and *M. quinquenodosum* (Redtenbacher), the umbilical tubercle is near the edge, and *M. campaniense*, de Grossouvre,\* though the young has a similar squarish section and low keel, differs in its dichotomous costation.

It may be added that in the holotype of *M. umkwelanense* the keel has quite disappeared near the end—a feature of great significance, but not sufficiently apparent from the original figure. In the present example the two outermost tubercles are not quite so close, the keel between them not quite so feeble and not quite lost at the end.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

#### 7. MORTONICERAS sp. aff. SOUTONI, Baily sp.

A large but somewhat fragmentary example (No. 5492), of 180 mm. diameter, agrees with the evolute specimen figured by Woods,† and has fairly smooth inner whorls, with the lateral tuberculation only just indicated. The ribs also are, then, quite indistinct. The five tubercles become as conspicuous as they are in Woods' example and in Redtenbacher's *M. quinquenodosum*,‡ only just before the beginning of the body-chamber (at a diameter of about 100 mm.). The body-chamber, however, develops increasingly strong tubercles, which character separates the example here described from the typical and more involute *M. soutoni*; for Baily's type shows decline of tuberculation at a stage when the present example develops its strong tuberculation, and in the specimen of *M. soutoni* mentioned under *M. woodsii* (see *supra*, p. 234) the outer whorl becomes almost smooth. There are twenty-seven costae, as in the specimen figured by Woods; near the end of the specimen the whorl-height is 64 mm. as compared with a thickness of 55 mm. The whorl-section, thus, is considerably thicker than that of *M. texanum*, Römer,§ which, however, it greatly resembles in the spacing of the tuberculation.

The writer agrees with Woods|| in considering *M. bontanti*, de

\* *Loc. cit.* (1894), pl. xiii, figs. 1 and 3.

† *Loc. cit.* (1906), p. 337, pl. xliii, fig. 1 a.

‡ "Cephal. Fauna d. Gosau-Sch. i. d. N.Ö. Alpen.," 'Abh. K.K.R.A.,' vol. v (No. 5), 1873, p. 108, pl. xxiv, fig. 3.

§ 'Die Kreidebild. v. Texas, etc.,' Bonn, 1852, p. 31, pl. iii, fig. 1 b (and 1 e?).

|| *Loc. cit.*, p. 338.

Grossouvre, to be quite different from Baily's species. On the other hand, the specimen figured as *M. texanum* by de Grossouvre\* agrees with the example here described, both in the character of the ornament and in whorl-section, though the inner whorls appear to be quite different in so far as the fragmentary condition of the present example permits of comparison. De Grossouvre's example may be identical with Hauer's *A. texanus*† = *A. quinquenodosus*, Redtenbacher,‡ as Lasswitz§ thinks, if the thinness of the latter species is due to crushing, but the writer cannot admit the same author's identification with *M. texanum* of de Grossouvre's *M. campaniense*, a form near to *M. delawareense*, with which, indeed, de Grossouvre|| subsequently united it.

*M. umkwelaneuse*, Crick,¶ has much thicker whorls, with a square section, but the specimen here compared with Crick's species,\*\* owing to the presence of a slight fifth (lateral) tubercle, is, perhaps, closer to the example under examination than is the type. In both, however, the umbilical tubercle is further away from the umbilical edge than it is in *M. sp. aff. soutoni*, and whereas in *M. umkwelaneuse* and in the close ally, described in this paper, the inner whorls are relatively more coarsely ornamented than the outer, the reverse development is found in the example here compared with *M. soutoni*.

It may be added that the great variability of the species here dealt with is shown in a large series of *Mortonicerias* from Pondoland in the British Museum, referred by Crick to Baily's two species and to an "intermediate" group.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

#### GEN. PSEUDOSCHLOENBACHIA, nov.

Genotype: *A. umbulazi*, Baily, 1855, pl. xi, fig. 4.

*A. umbulazi*, Baily, described as *Schloenbachia* by Woods†† and Crick,‡‡ has been considered by Kossmat§§ to belong to the "narrowly-

\* *Loc. cit.* (1894), pl. xvii, figs. 1 a, b, non pl. xvi, figs. 2-4.

† "Ceph. d. Gosau-Sch.," 'Beitr. z. Pal. v. Österr.,' vol. i, 1858, pt. i, p. 10, pl. ii, figs. 4-6.

‡ *Loc. cit.*, p. 108, pl. xxiv, fig. 3.

§ "Kreide-Amm. v. Texas," 'Geol. und Pal. Abh. Koken,' n.f., vol. vi (1904), p. 31.

|| 'Recherches s. l. Craie Supér.' (1901), p. 379.

¶ *Loc. cit.*, p. 228, pl. xv, fig. 9.

\*\* See above, p. 234.

†† *Loc. cit.* (1906), p. 336.

‡‡ *Loc. cit.* (1907), p. 250.

§§ "Die Bedeut. d. Südind. Kreideform., etc.," 'Jb. K.K.R.A.,' vol. xlv (1894), p. 464.

umbilicated *Schloenbachia* (*Prionocyclus*) forms that appear in the Lower Senonian," and to be closest to *A. paon*, Redtenbacher, and to *A. haberfellneri*, Hauer. The genus *Barroisicerias*, however, to which these two species belong, is characterised by a simplifying suture-line; and whereas its typical branch develops a concave periphery, another group (with acute periphery) tends towards certain Tissotids. Solger,\* who doubtfully classed *A. umbulazi* in *Muniericerias*, appears to have been much nearer the mark. The young *A. umbulazi* reproduces the ornament of *Muniericerias lapparenti*, Grossouvre,† and has chevrons on the venter, but no keel (Fig. B 2). But before this stage, the young *A. umbulazi* reproduces *Puzosia*, with constrictions (Fig. B 3), and the suture-line throughout shows great resemblance to that of many Desmoceratids. There is, however, at least an equally great similarity, shown by the apparently continuous series *Sonneratia-Cleonicerias* and of *Hoplites-Pleurohoplites*‡-*Schloenbachia*§ with certain contemporary Desmoceratids: also, possibly, *Muniericerias* itself includes Prionotropid forms (Grossouvre's species, *M. gosauicum*, Hauer sp., *M. dresdense*, Petraschek) and Desmoceratid species, e.g. the lower Senonian *A. clypealis*, Schlüter and Brauns,|| and "*Desmoceras*" *clypealoides*, Leonhard,¶ apparently connected with the Turonian *Puzosia hernensis*, Schlüter sp. Thus the presence of constrictions on the inner whorls of *P. umbulazi*, and a suture-line that resembles that of certain Desmoceratids, are not definite proof that *Pseudoschloenbachia* be derived from *Puzosia* rather than from *Prionotropidae*, viâ *Muniericerias*. Constrictions may appear in *Schloenbachia* as well as in *Pseudoschloenbachia* and *Gauthiericerias* and other genera (e.g. *Hystatoceras*, *Anahoplites*) apparently quite spontaneously, and one example of *Schloenbachia varians* in the writer's collection shows constrictions, like *Gauthiericerias fournieri*, Grossouvre sp., with deep chevrons across the venter, accompanied by decline of ornament and loss of keel.\*\* At any rate, if comparison is at all permissible with the rather distant *Hauericerias*, a Desmoceratid

\* "Foss. Mungokreide," 'Beitr. z. Geol. v. Kamerun, II' (1904), p. 205.

† *Loc. cit.* (1894), p. 158, especially pl. xxxv, fig. 3.

‡ Gen. nov. for *stuederi* group, Jacob em. Spath (genotype, *A. renauxianus*, d'Orbigny, 'Pal. Franç. Ter. Crét.,' pl. xxvii).

§ *Varians*-group only.

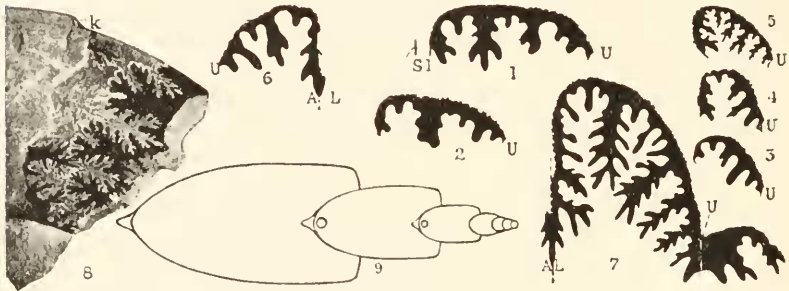
|| de Grossouvre (*loc. cit.*, p. 175) has pointed out that Brauns' form is different from Schlüter's type.

¶ "Fauna d. Kreidef. Oberschles.," 'Palæontogr.,' xlv (1897), p. 57, pl. vi, figs. 2 a, b.

\*\* This excludes any possibility of a connection between *Prohauericerias* or *Pseudoschloenbachia* and the true *Schloenbachia*.

genus with acute periphery, the group of "*Schloenbachia*" here discussed would be post-*Hauericerus*, not pre-*Hauericerus*, speaking phylogenetically, and irrespective of age—in other words, it would have travelled farther away from the Desmoceratid stock than *Hauericerus*.

Now Nowak\* proposed the new genus *Prohauericerus* for those forms of *Schloenbachia* that showed a decided tendency in the direction of *Hauericerus*. The derivation of the latter genus from *Schloenbachia* (via *Prohauericerus*) can on no account be admitted. *Hauericerus* has a truly Desmoceratid suture-line, as a comparison of its internal sutures (Fig. A 7) with those of *Puzosia planulata* (Sowerby), Kossmat,†



TEXT-FIG. A.—*Hauericerus gardeni*, Baily, sp. Umtamvuna River, Natal. (B.M. No. C 18528 [1 7 and 9] and C 18531 8'). 1. Suture-line at diameter = 4 mm. *sl* = siphuncle; *u* = umbilicus. 2. Ditto at 6 mm., without external saddle. 3. Second lateral saddle and auxiliaries at 14 mm. D. 4. Ditto at 20 mm. D. 5. Ditto at 50 mm. D. 6. Internal (dorsal) suture-line at diameter = 6 mm.; *AL* = antisiphonal lobe; *u* = umbilicus. 7. Ditto at 50 mm. D. with second and third auxiliary saddles of external suture-line, and umbilical saddle (*u*). *A.L.* = antisiphonal lobe. 8. Whorl-fragment at D = 90 mm., *κ* = hollow keel, on barely carinate venter of east. (Photo. by G. C. Crick.) 9. Outline whorl-section at D = 75 mm., showing hollow keel and rounded inner whorls. All the figures are enlarged.

will show. The inner branch of the second lateral saddle, that is so conspicuous a feature of the development of the suture-line of *Hauericerus gardeni* (see Fig. A 1–5)‡ is similarly developed in many forms of *Puzosia* (e. g. *subplanulata*, Schlüter, *compressa*, *indopacifica*,

\* "Unters. Ceph. Ob. Kreide Polen., III," 'Bull. Ac. Sci. Cracovie,' June, 1913, p. 370.

† *Loc. cit.* (1898), pl. xvi, fig. 4.

‡ The specimen (B.M. No. C18528) from which these figures were drawn, agrees in all respects with Baily's type (B.M. Geol. Soc. Coll., No. 11370), and the larger of the two fragmentary co-types (No. 11371) from which Baily's figure of the suture-line was taken. Some Japanese examples of *H. gardeni* in the British Museum (Geol. Soc. Coll.) also show this peculiarity of the suture-line, figured by various authors, in exactly the same manner.

Kossmat, *gaudana*, Forbes, etc.). When ornament appears in *Hauericeras* (*H. buszii*, var. *nodosa* and var. *costata*, Wegner\*), it does so at a late stage; and the periphery of the cast is barely sharpened in *H. gardeni* at a diameter of 60 mm., which accounts for the fact that, e. g., Pervinquierè,† who, unlike Nowak, clearly recognised the hollow keel, found the casts of his small examples perfectly rounded.

The assemblage mentioned by Nowak includes Albian, Cenomanian, Turonian and Senonian forms and is most heterogeneous. Sharpe's *A. goupilianus* (non d'Orbigny) is only a smooth variety of *Schloenbachia varians*, Sowerby sp. Whiteaves' newly-created *Schl. propinqua* has as little to do with Stoliczka's earlier *A. propinquus*, as Anderson's *Schl. propinqua*‡ (Stol.), possibly a Turonian Prionotropid, is related to the Indian species. Such Albian forms as *A. acuto-carinatus*, Shumard, belonging to the group of *A. roissyanus*, d'Orbigny, § again, are as little related to the true Cenomanian *Schloenbachia* or to "*Prohauericeras*," as the Neocomian *Oosterella cultrataeformis*, Uhlig sp., is to either.

Since *Prohauericeras* has been proposed, it may be convenient to retain it|| for *A. goupilianus*, d'Orbigny, which apparently was intended to be the type, since Nowak mentions it first, and refers to it again in connection with "*Schloenbachia*" *fouruieri*, Grossouvre, and "*S.*" *obesa*, Stoliczka sp. In suture-line, as well as in other characters, this restricted *Prohauericeras* differs both from the true Cenomanian *Schloenbachia* and from its own (Turonian) contemporaries among the *Prionotropidae*. On the other hand, *Pseudoschloenbachia* is quite different again from any of these developments. Its internal suture-line (Fig. B 5 and 6) is figured for comparison with that of *Schloenbachia varians* (Fig. B 10); and it will be seen that it differs very considerably, especially from that of *Hauericeras*. As, however, more involute forms of *Puzosia* and other Desmoceratids, including the keeled "*P.*" *sugata*, Forbes sp., show, the stretching out of the auxiliary elements may only be the result of adaptation of a suture-line to wider sides, and the raising of the umbilical portion is often found in younger developments. The suture-line by itself thus is as unsatisfactory a character in many cases as, say, the carination would be, if taken as the only basis for classification.

\* "Die Granulat. Kr. d. W. Münsterland.," 'Zert. D. Geol. Ges.,' vol. lvii (1905), p. 208, pl. viii, figs. 1 a and b.

† *Loc. cit.* (1907), p. 165.

‡ *Loc. cit.* (1902), p. 123, pl. ii, figs. 34-38. Anderson (p. 63) also compared Whiteaves' "*S.*" *propinqua* with the Utatur form.

§ See under *Pseudophacoceras* (p. 283).

|| The name is no more unsuitable than is, e. g., Frech's *Paralytoceras* for a Devonian Clymenid.



The hollow keel of *Hauericeras*, appearing comparatively late in ontogeny, cannot be a development of the solid keel of *Schloenbachia*, in which genus it appears after the costation, and, occasionally, tuberculation, and after the shell had become fairly involute. Similarly, the ibex-like periphery of the young *Pseudoschloenbachia* is not in favour of a possible connection of this genus either with *Schloenbachia* or with *Prohauericeras*. The various Natal forms indicate that this stock had its own involute and smooth developments (*P. griesbachi*, Crick MS.) and highly tuberculate and constricted forms (*P. papillata*, Crick MS.), and transitions between these extremes. There are oxycone developments with simplifying suture-lines (*Eulophoceras* and *Spheniscoceras*), and a hitherto unknown group (*Diaziceras*) that shows a superficial resemblance to the South American Lenticeratids, and is interpreted as a link connecting *Pseudoschloenbachia* with those genera (*Eulophoceras-Spheniscoceras*) that carry the simplification of suture-line and specialisation of whorl-shape to a higher degree. It is probable that these clearly allied forms are only indirectly connected with Desmoceratids, and that *Pseudoschloenbachia* via *Muniericeras* (and like *Gauthiericeras*, to which probably *S. bertrandi*, *S. fournieri*, Grossouvre,\* and the forms of the Syrian Senonian have to be added) is derived from *Prionotropidae*.

8 and 9. PSEUDOSCHLOENBACHIA UMBULAZI, Baily sp.

(Pl. XX, figs. 2 and 3; Text-fig. B 2-7).

1906. *Schloenbachia umbulazi* (Baily). Woods, "Cret. Fauna of Pondoland," Ann S. Afr. Mus., vol. iv, part vii, No. 12, p. 336. (See there for synonymy.)

Two specimens are referred to this form, the smaller one (No. 5494) (Pl. XX, fig. 2) agreeing particularly well in costation with Baily's type-figure. Its dimensions are:

Diameter	.	.	.	43 mm.
Height of last whorl	.	.	.	51 per cent. of the diameter
Thickness	"	"	.	28 " " "
Umbilicus	.	.	.	13 " " "

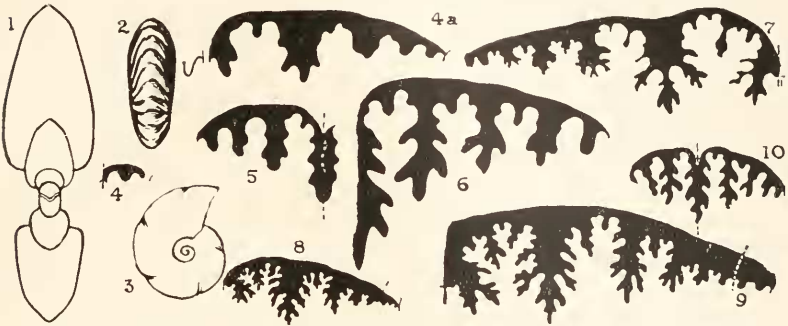
The larger specimen (No. 5459) is less coarsely costate at the same

\* A specimen of "*Schloenbachia boreauxi*, Grossouvre, from the Middle Coniacian of the Charente Inferieure (B.M. No. C7387) shows that the group of "*S. fournieri* is more nearly allied to *Gauthiericeras*, and has nothing to do with the probably Campanian *Pseudoschloenbachia*.

diameter, but develops the typical ornament, with distinct umbilical tubercles, on the outer whorl. It has the following dimensions :

Diameter	. . . . .	59 mm.			
Height of last whorl	. . . . .	54 per cent. of the diameter			
Thickness	.. .. .	27	..	..	..
Umbilicus	. . . . .	13	..	..	..

Both the specimens show the suture-lines well and have portions of the body-chambers preserved, the former rather less than the last half of the outer whorl, the larger specimen a little over half a whorl.



TEXT-FIG. B.—1. *Pseudoschloenbachia umbulazi*, Baily sp., Umtamvuna River, Natal (B.M. No. C19427). Sectional outline of inner whorls (at diameter = 32 mm.). 2. 6. *Pseudoschloenbachia umbulazi*, Baily sp., Umkwelane Hill, Zululand (Specimen No. 5494) (p. 240). 2. Ventral aspect of inner whorls showing chevrons at D = 12 mm. 3. Lateral view of innermost whorls at D = 5 mm. 4. Ditto, suture-line at D = 2 mm. 4A. Ditto, suture-line at D = 4 mm.. 5. Ditto, internal suture-line at 4 mm. 6. Ditto, internal suture-line at 16 mm. 7. *Pseudoschloenbachia umbulazi* (Baily) var. *acuta*, nov. Suture-line of type-specimen (No. 5450) from Umkwelane Hill (p. 241). 8. *Pseudoschloenbachia griesbachi* (Crick MS.), Umtamvuna River, Natal (B.M. No. C19428). Suture-line of type-specimen at D = 60 mm. (reduced  $\frac{2}{3}$ ). The edge should be minutely frilled. 9. *Aconeceras nisoides*, Sarasin, sp. Suture-line of specimen No. 5119 from Powell's Camp, Upper Catembe (p. 311). 10. *Schloenbachia varians* (Sowerby), Cenomanian, Warrinster, Wilts. (Coll. L. F. Spath). Internal suture-line at diameter = 15 mm. All the figures except 8 are enlarged.

An immature third example (No. 5450) (Pl. XX, fig. 3) of 24 mm. diameter, and wholly septate, agrees with the first specimen described and with Baily's type-figure in the distinct costation,\* but has a thinner section at an equal diameter and an acutely fastigate periphery. It may be separated as—

var. ACUTA, nov.

Mr. Woods stated that *P. umbulazi* appeared to be confined to Pondoland. In addition to the present specimens from Zululand,

\* There is no tubercle on the ribs at the middle of the side, as might wrongly be inferred from the side-view given in Pl. XX, fig. 3.

there is an immature, evolute specimen from the Umpenyati River, Natal, recorded by Crick\* ; on the other hand, five specimens from the Umtamvuna River, Natal, in the British Museum, identified by Crick, represent more strongly ornamented varieties, with increasing tuberculation round the umbilicus. One of these examples (No. C19425) is slightly constricted and transitional to a highly tuberculate species named "*Schloenbachia papillata*" by Crick.

Specimens of the latter species, also of the transitional form, from Zululand and belonging to the Albany Museum, were sent to the writer in 1914 through the kindness of Mr. Woods, but since Crick had been at work on his paper on this fauna for many years, and since there were only a few specimens, they were not described. *P. papillata*, G. C. Crick MS. sp., is not represented in the present collection,† nor are the transitional forms, referred to above.

The three specimens were collected at Umkwelane Hill, Umfolozi, Zululand (Coll. Dr. A. L. du Toit).

#### GEN. DIAZICERAS, nov.

Genotype: *D. tissotiaeforme*, sp. nov., p. 245, Pl. XIX, figs. I a-k.

This genus is created for one form in the collection that cannot be included in any of the known genera of keeled Senonian Ammonites. Its suture-line stamps it as being near to the genera *Eulophoceras*, Hyatt, and *Spheniscoceras*, Crick MS.,‡ and in general outline this

\* *Loc. cit.* (1907), p. 250.

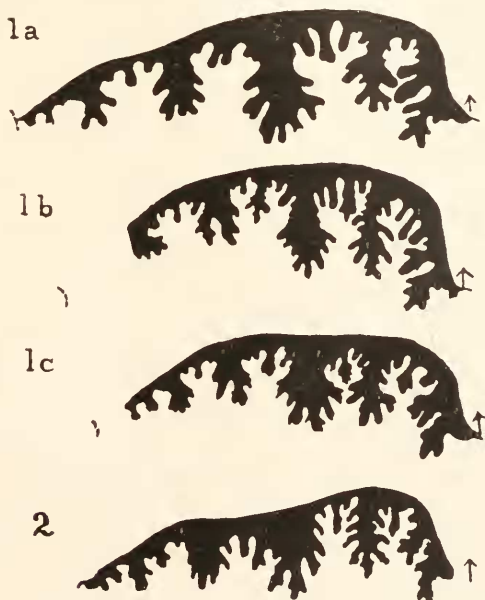
† Two additional specimens of this species were included in the collection from the Durban Museum, already referred to, and will be figured.

‡ This genus was created for the three species *S. africanum*, *S. minor* and *S. tenue*, G. C. Crick MS., which obviously are the "other species of *Eulophoceras*" referred to by Woods (*loc. cit.*, p. 337). Crick, in his diagnosis of the new genus, does not in any way mention the genus *Eulophoceras*, which, however, is very close, as will be seen on comparing the suture-lines given in Text-fig. C 1 with that of *Eulophoceras natalense*, Hyatt (Text-fig. C 2, after Woods, *loc. cit.*, pl. xlii, fig. 3), and with Hyatt's type (*Pseudoceratites*, 1903, p. 86, pl. xi, figs. 2-6). On the other hand, Crick considered the new genus to be "intermediate between *Pluenticeras* and *Sphenodiscus*," which statement is meaningless, even from a purely morphological point of view, for *Spheniscoceras* has a thickened keel, after the style of that of the remarkable form figured as *A. roissyanus*, d'Orbigny, *varietas*, by Ooster (Catalogue, etc., 1860, pl. xxvi, fig. 7), or of certain *Dipoloceras* and *Pseudophacoceras* described in this paper (see, *c. g.* Pl. XXV, fig. 1 d, and Pl. XXVI, fig. 5 b), placed on a very thin and acute whorl. This is an exaggeration of the feature shown in Hyatt's fig. 6 a of pl. xi, but of doubtful generic importance. *Hauriceras rembda*, Forbes, shows a similar feature occasionally. In fact the writer is not convinced that Crick was right in



suture-line agrees with the South American *Lenticeras* and *Paralenticeras* included by Hyatt in the family *Eulophoceratidae*.<sup>\*</sup> These genera, however, include more or less smooth forms, whereas the new genus here proposed is characterised by strong ornament. The latter consists of very prominent umbilical tubercles, each connected by obscure broad ribs with about five outer tubercles. This type of ornament is found in the Senonian in certain *Pseudoschloenbachia* (*P. papillata*, G. C. Crick MS.), in *Barroisiceras* (*desmoulini*) and in certain Tissotids. The first genus has a highly complex suture-line, characterised by a very deep principal lobe, whereas the suture-line of the new genus shows signs of simplification in the peculiar rounding

separating the forms he described from *Eulophoceras*. *Eulophoceratidae* may be distantly related to the contemporary *Sphenodiscidae* (not the Turonian *Codopoceratidae*, often confused with *Sphenodiscidae*), but there is no connection



TEXT-FIG. C.—1. *Spheniscoceras*, G. C. Crick (MS.), Upper Senonian, Umtamvuna River, Natal. (After drawings, of the natural size, by the late G. C. Crick.) 1 a. *S. africanum*, Crick MS. (genotype), B.M. No. C19421. 1 b. *S. minor*, Crick MS. (B.M. No. C19422). 1 c. *S. tenue*, Crick MS. (B.M. No. C19423). 2. *Eulophoceras natalense*, Hyatt (after Woods), Pondoland. For comparison.

whatever between *Spheniscoceras* or any other *Eulophoceratid* and the *Placenticeratidae*.

<sup>\*</sup> *Loc. cit.*, 1903 (*Pseudoceratites*), p. 16, also wrongly including *Tegoceras*, Hyatt, which is a *Hystatoceratid*.

of the terminal folioles, the short and simple lateral lobe, and the beginning development of adventitious lobes.

*Barroisicerus* includes shells (e. g. *B. desmoulini*, Grossouvre sp.) that are near the new genus in external shape, though less so in suture-line, and these forms with persistent keel, at any rate, may have to be excluded from *Barroisicerus*, since the typical group of this genus develops a concave periphery.

*Tissotidae* have a pseudoceratitic suture-line, quite different from that of the genus here described, though certain forms, e. g. *Metatissotiaourneli*, Bayle sp., somewhat resemble it in external shape. The earlier *Pseudotissotidae* have a less simplified suture-line, but cannot have given rise to a highly ornamented descendant in the Senonian such as the form here described.

Derivation from the main stock of the normally-lobed *Prionotropidae*, through *Pseudoschloenbachia*, is most probable, and it seems that whereas *Diazicerus* is nearer to the ancestral *Pseudoschloenbachia* in ornamentation, *Spheniscoceras* and *Eulophoceras* are, perhaps, closer to it in suture-line. It might be advisable to retain Hyatt's family *Eulophoceratidae* for these four genera, all presumably of Campanian age, but though there is a certain family resemblance with the suture-lines of *Eulophoceras* and *Spheniscoceras* (cf. Fig. C 1a) and less so with *Pseudoschloenbachia*, the similarity of the suture-line of *Diazicerus* with those of *Lenticeras*, *Paralenticeras* and other pre-Campanian genera makes it doubtful whether in the present state of our knowledge a subdivision of the Senonian *Prionotropidae* can yet be attempted. Moreover, an undescribed form, closely resembling "*Barroisicerus haberfellneri*" from Madagascar, as figured by Boule, Lemoine and Thévenin,\* but possibly nearer to the Upper Chico "*Schloenbachia*" *chicoensis*, Trask sp. (Anderson†) occurs in Pondoland, associated with many Campanian species, but also with "*Puzosia*" *sugata*, Forbes sp., which occurs in the Lower Chico Beds of California, and in Lower and Upper Senonian beds in India and elsewhere. The likeness of these presumed Campanian forms with *Barroisicerus* may only be accidental, and since the median row of ventral tubercles in the new Pondoland form is very high and acute, it may well be assumed to lead from e. g. *Muniericeras* to *Pseudoschloenbachia* and *Diazicerus*. On the other hand, it looks as though a revision of the many forms of "*Schloenbachia*" in the Lower and Upper Chico Beds were most likely to throw light on the possible connection between *Diazicerus* and *Barroisicerus* on the one hand, and

\* *Loc. cit.* ii (1907), p. 43, pl. xi, fig. 3.

† *Loc. cit.* (1902), p. 116, pl. ii, figs. 23-25.

*Pseudoschloenbachia* and *Ganthericeras* and *Muniericeras* on the other.

The uncertainty as to the presence of pre-Campanian horizons in the Senonian of Pondoland and Umkwelane Hill is an additional difficulty. Though, thus, the close resemblance of the suture-line of *Diaziceras* with that of, e. g., *Lenticeras andii*, Gabb sp., and *L. baltai*, Lisson,\* might be explained by the mechanical laws that govern the formation of the Ammonite-septum and its edge,† yet it is curious that as *Lenticeras* is associated with *Mortoniceras texanum*, so *Diaziceras* occurs together with the comparable *M. umkwelanense*, whereas the presence of *Peroviceras* in Zululand, and of "*Puzosia*" *sugata* and the above new form in Pondoland, suggests that the new genus may be closer to Coniacian genera than is here assumed. Unfortunately the writer has no comparable material for dissection.

#### 10. DIAZICERAS TISSOTIAEFORME, NOV.

(Pl. XIX, figs. 1 a-k.)

This species is based on a completely septate specimen (No. 5478) having the following dimensions :

Diameter	. . . . .	80 mm.
Height of the last whorl	. . . . .	50 per cent. of the diameter.
Thickness	„ . . . . .	59 „ . . . . .
Umbilicus	. . . . .	14 „ . . . . .

The small and deep umbilicus is surrounded by four very prominent tubercles, increasing in size with age, and each connected by faint ribs, with about five smaller rounded tubercles on the ventro-lateral edges. The prorsoradiate processes of these tubercles towards the very sharp ventral edge are very faint, so that the roof-shaped periphery is almost smooth. Where the shell is preserved on the ventral edge, near the end of the specimen, it follows the shape of the fastigate periphery of the cast, but at the beginning of the last whorl, where the peripheral character of the inner whorl is well shown, the shell rises in a distinct keel above the less acute ventral edge of the cast. The whorl section is polygonal, with the greatest whorl-thickness at the umbilical tubercles, and the two ventral and the two lateral faces concave, but the umbilical slopes convex.

\* *Loc. cit.* (1908), pls. xiii and xiv.

† See the writer's "Notes on Ammonites," *Geol. Mag.*, 1919, January to May numbers, and compare, e. g., the suture-lines of *Pseudophacoceras* (Pl. XXV, fig. 1 b and c), and *Oxynticeras* (Pia, 1914, pls. viii-xi), or of *Aconeceras nisoides* (Fig. B 9, p. 33) and *Pseudoschloenbachia griesbachi* (Fig. B 8).

There are twelve septa on the last whorl. The most striking characteristics of the suture-line are the very deep external lobe and reduced first lateral lobe, the trifid external saddle and the peculiar rounding of the terminal folioles of all the saddles. These characters are found in the suture-lines of *Leuticeras andii*, Gabb sp., *L. baltai*, Lisson, and of *Paralenticeras sieversi*, Gerhardt sp.,\* and of the two close allies—*Eulophoceras* and *Spheniscoceras*, which here are assumed to represent developments of the same stock. On the other hand, the suture line of "*Barroisiceras*" *desmoulini*, Grossouvre sp., as figured by Solger,† though showing a superficial likeness, differs considerably in its short external lobe, broad-stemmed external saddle and very simple outlines, even of the internal portion. This species, however, shows the greatest resemblance to the present species in its polygonal whorl shape. There are differences in ornament, but the important distinction is the presence of ventral tubercles in Grossouvre's form, which, when worn, may present the appearance of an entire keel. Solger's Cameroons specimens had an entire keel from the youngest stage, but differ from the Zululand example in proportions, ornament, and in having the peripheral tubercles elongated longitudinally. One of Solger's specimens also becomes quite rounded ventrally in the adult, so that these Coniacian forms may belong to quite a different stock from the presumably Campanian *Diaziceras*.

*Pseudoschloenbachia papillatu*, G. C. Crick (MS.) sp., is a considerably thinner form, with eight umbilical tubercles, each corresponding to about four outer tubercles. It has a higher keel than is shown in the sectional views of *Gauthiericeras bertrandi* and of *G. furnieri* in Grossouvre,‡ and has much more prominent umbilical tubercles. But in *Pseudoschloenbachia* the suture-line is quite complex and characterised by a large and deep first lateral lobe. A comparison of fig. B 4a (p. 241) with fig. 1k of Pl. XIX will show that whereas *Pseudoschloenbachia* at 4 mm. diameter is much more advanced than *Diaziceras*, as regards elaboration of the septal edge, the latter genus shows a deeper ventral lobe, with the whole suture-line rising towards the umbilicus—generally a feature of later developments. The *Muniericeras* stage of *Pseudoschloenbachia* cannot be traced in *Diaziceras*, and it has already been pointed out that there is a possibility of the keel of these two genera being a development of the

\* "Beitr. z. Kenntn. d. Kreideform. in Venezuela und Peru," in Steinmann, "Geol. und Pal. v. S. Amer.," V, 'N. Jb. f. Min., etc.,' Beil.-Bd. xi, 1897, p. 82, text-fig. 6, and p. 79, text-fig. 5.

† *Loc. cit.* (1904), pp. 168 and 169, text-figs. 53 and 54.

‡ *Loc. cit.* (1894), pl. xxix, fig. 6b, and pls. xxxv, figs. 1b and 1c.

crenulated keel of certain Upper Chico forms that cannot safely be referred to such known genera as *Muuiericeras* or *Barroisiceras*, and probably are later than either.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

## FAMILY : PLACENTICERATIDÆ.

### GEN. PLACENTICERAS, Meek.

#### II. PLACENTICERAS SUBKAFFRARIUM, sp. nov.

(Pl. XXI, figs. 2 a-d.)

This species is based on a fairly well-preserved specimen (No. 5106) of the following dimensions :

Diameter . . . . .	85 mm.
Height of last whorl . . . . .	50 per cent. of the diameter
Thickness „ „ . . . . .	37 „ „ „
Umbilicus . . . . .	15 „ „ „

About one-half of the outer whorl belongs to the body-chamber, but the mouth-border is not preserved. The suture-line given in Fig. 2 d was taken at the beginning of the last whorl.

The species differs from *P. kaffrarium*, R. Etheridge fil.,\* in having a smaller umbilicus (surrounded by tubercles that are very prominent already on the inner whorls, as shown in the umbilicus), in having a wider ventral area, and in the great thickness, caused by the prominent umbilical tubercles. The very conspicuous lateral ribs of *P. kaffrarium*, on the other hand, are not found in the example here described, but it should be mentioned that near the end of the specimen, where the shell has been removed, the lateral folds are more distinct on the internal cast than they are on the shell. The latter only shows very indistinct ribbing between the seven umbilical tubercles and the twenty-eight elongated outer prominences (unpaired) that border the flat and smooth ventral area. In addition to this distant ribbing, there are fine sigmoidal striæ, both on the shell, as in *P. tamulicum* (Blanford) Kossmat,† and on the cast of the body-chamber, as in *P. stantoni*, var. *bolli*, Hyatt.‡

*P. tamulicum*, which, like the present species, belongs to the group of *P. syrtales*, Morton, is distinguished from the form here described

\* *Loc. cit.* (1904, Second Report), p. 89, pl. iii, fig. 16.

† *Loc. cit.* (1895), p. 174, pl. xxii (viii), figs. 1 a-c.

‡ “Pseudoceratites of the Cretaceous,” ‘Mon. U.S. Geol. Surv.’ vol. xliv (1903), pl. xli, fig. 7, p. 214.

by being much thinner, by having more delicate ornamentation, a narrower siphonal area, with less prominent and closer nodes, and slight differences in the suture-line, *e. g.* the first adventitious lobe is smaller than the second one in *P. subkaffrarium*, whereas the reverse proportions are noticeable in the Indian species.\*

*P. stantoni*, var. *bolli*, Hyatt,† also is a close ally of the present species, as is *P. intermedium*, Johnson,‡ the latter only distinguished from the Zululand form by a narrower ventral area and a wider umbilicus.

*Locality*.—Umkwelane Hill, Umfolozi, Zululand. Coll. J. S. Hedges.

## FAMILY: NOSTOCERATIDÆ.

### GEN. NOSTOCERAS, Hyatt.

#### 12. NOSTOCERAS ? NATALENSE, sp. nov.

(Pl. XXII, figs. 2 a, b.)

A depressed turricone (No. 2746) with the apical portion missing, like the somewhat similar *Didymoceras* ? *newtoni*, Whitfield sp., cannot definitely be referred to either *Didymoceras* or *Nostoceras* until more complete specimens are known. The example is distinct enough, however, to justify a new specific designation.

The two and a quarter whorls preserved are septate throughout, and though the suture-lines are too indistinct for delineation, they appear to be of the same general plan as that of *Nostoceras* ? *subangulatum*, nov., with the external lobe and its small median (siphonal) saddle between the two rows of tubercles. These are very prominent, elongated, and continued on the under surface of the whorls into simple and strongly forwardly inclined ribs, somewhat like those of *D. umbilicatum*, Meek,§ but more oblique, and with a very steep backward edge. On the upper surface of the whorls the costae bifurcate at the tubercle, as in *D.* ? *tricostatum*, Whitfield,|| which Hyatt¶ considered to be the possible gerontic stage of *D.* ? *newtoni*.

\* *P. syrtale*, Morton, var. *tamulicum* (Blanford), Kossmat in Boule, Lemoine and Thévenin (*loc. cit.*, II, 1907, p. 47, pl. xii, figs. 3 and 4), is very close to the Zululand specimen, but apparently possesses the outer tubercle of *P. syrtale*.

† *Loc. cit.*, "Pseudoceratites," 1903, as above, also, *e. g.*, pl. xliii, fig. 1.

‡ 'The Geol. of the Cerrillos Hills, New Mexico,' part ii, 'Palaeont.,' School of Mines Quarterly, vol. xxiv, no. 2, 1903, p. 206, pl. viii, figs. 27 a, b.

§ "Invert. Cret. and Tert. Foss.," 'U.S. Geol. S. Territ.,' vol. ix (1876), pl. xxii, fig. 5.

|| "Pal. Black Hills, Dakota," 'U.S. Geol. S.' (1880), pl. xv, fig. 7.

¶ "Phylogeny of an Acquired Characteristic," 'Proc. Am. Phil. Soc.,' vol. xxxii (1894), p. 574.



Only in the Zululand species, there generally is only a thick posterior and a fine anterior branch, without the intermediaries found in both the Dakota forms. The new form of *Didymoceras*, figured by Schlüter on pl. xxxv, figs. 1-4, as *Heteroceras polyplacum*?, showing bifurcation only, is, perhaps, closer to the form here described in this respect, but the tubercles are far too fine. The whorl-section is as compressed as that of Schlüter's loosely coiled form,\* and less rounded than that of *D. ? newtoni*, which has a larger umbilicus. That of the present species is as small as the umbilicus of *D. pauper*, Whitfield sp., or that of *D. archiacianum*, d'Orbigny sp., which latter also shows a similar forward sweep of the costation on the under surface.

Since the apex of the spire is not preserved, it is impossible to state whether the early whorls were closely coiled, as seems probable from the presence of a contact furrow on the upper surface of the highest whorl, or whether the apex was an irregular spiral, as is the case in so many forms of this group (*Didymoceras*). The coiling of the portion that is preserved is the same as that of *Turrilites acutus*, Passy, also recorded from Zululand by Crick.† “*Turrilites*” *tridens*, Schlüter,‡ also shows similar coiling, but the drawing appears deceptive, and the writer is inclined to consider this species to belong to *Hyphantoceras*, to judge by the under-surface of the whorls.§

If the form here described is a *Nostoceras*, it probably represents a less specialised type than *N. stantoni*, Hyatt||; for the single costae with two lines of tubercles, so characteristic of *Exileloceras*, are found in the young of *Nostoceras stantoni* and of *N. helicinum*, Shumard sp.¶ The latter form has a very short spire like the Zululand form, with a deeply impressed suture, but the costation is quite different.

*Locality*.—Umfolozi Valley, East of Railway. Coll. Mr. Illingworth.

\* This shows close resemblance to a beautiful specimen of *Emperoceras simplicostatium*, Whitfield sp. (larger than the example figured by Whitfield, ‘Bull. Am. Mus. Nat. Hist.’ vol. xvi, 1902, pl. xxvii), in the B.M. (No. C10808), and though the earlier whorls apparently are quite different from those of *Nostoceras* and *Didymoceras*, the ornament of the last volution strikingly recalls that of *D. ? newtoni*, Whitfield sp., and of *D. ? cooperi* (Gabb) Whiteaves (B.M. from Vancouver).

† *Loc. cit.* (1907), p. 176, pl. xi, figs. 3 and 4.

‡ *Loc. cit.* (1872), pl. xxxv, fig. 9.

§ The trituberculate (?) *Turrilites peramplus* Lasswitz (*loc. cit.*, p. 14, pl. ii, fig. 1) also resembles the present form somewhat in shape, but may be a true *Turrilites*, though Lasswitz compares it with Schlüter's “*Turrilites*” *tridens*.

|| *Loc. cit.* (1894), p. 570.

¶ “Descr. of New Cret. Foss. from ‘Texas,’” ‘Proc. Boston Soc. Nat. Hist.’ vol. viii (1861), p. 190.

13. NOSTOCERAS? SUBANGULATUM, sp. nov.  
(Pl. XXII, figs. 3 a-c.)

A sinistrally coiled, fairly elevated but fragmentary turricone (No. 2746A), consisting of just over two whorls of body-chamber and of a small portion of the septate and possibly more loosely coiled earlier whorls, is doubtfully referred to the genus *Nostoceras*. There is great resemblance to the dextrally coiled *Didymoceras? stvensoni*, Whitfield sp.,\* and the helicoid character of the earlier whorls, if proved by the discovery of more perfect examples, may necessitate the transfer of the new form to the genus *Didymoceras*; on the other hand, the beginning of the example here described already shows an impressed zone of contact, so that the reference to *Nostoceras* seems most proper. Like the species last described, the present example with its strong, simple costation and double row of ventral tubercles recalls the ornamentation of the genus *Exiteloceras*, and the fragment of *Ex. angulatum* figured by Meek,† shows a close resemblance to the septate portion here described, though there is a considerable difference in size. The openly helicoid or irregular coiling of the young of *Exiteloceras*,‡ however, is quite distinct.

The whorl-section is almost rounded, except for the double row of tubercles on the ventral area, slightly below the middle, and the impressed zone on the upper surface, indicating affinity with *N. stantoni* and "*N.?*" cf. *stvensoni* (Whitfield) in Hyatt.§ The costation is very irregular; on the small septate portion, the costae have a very steep forward edge and a gentle slope backward, and are continuous between the slight tubercles. On the under-side they are projected strongly forward, towards the umbilicus, as in the basal view of *Didymoceras? stvensoni*, Whitfield sp.|| On the upper surface they describe first a backward curve, and then, in the contact furrow,

\* "Note on a Very Fine Example of *Helicoceras stvensoni*, etc.," Bull. Am. Mus. Nat. Hist., vol. xiv (1901), p. 219, pls. xxix and xxx.

† *Loc. cit.*, 1876, p. 484, pl. xxi, fig. 3 (perhaps a fragment of a *Didymoceras?*).

‡ Hyatt (*loc. cit.*, p. 577) calls *Hamites fremonti*, Marcon (holotype in B.M., Geol. Soc. Coll., No. 12667), probably a gerontic stage of some species of *Exiteloceras*, which is doubtful, the former probably being of Albian age, and close to "*Anisoceras alternatum*," Pict. & Camp. non Mantell (*loc. cit.*, 1861, pl. li). *Helico. pariense*, White, also, in the writer's opinion, is not an *Exiteloceras*, and with the so-called "*Crioceras ellipticum*, Mantell," of Schlüter and other authors, and similar Turonian forms, belongs to a new, unnamed genus.

§ *Loc. cit.* (1894), pp. 568 and 571.

|| *Loc. cit.* (1880), pl. xiv, fig. 7, and *loc. cit.* (1901), pl. xxx. This form seems to differ from the species here described only in the uncoiling of the body-chamber.



a reverse curve that is strongly convex forwards. A somewhat similar costation is shown on the upper whorl-surface of *D. pauper*, Whitfield sp.,\* and of *D. ? conradi*, Morton sp., in Whitfield.†

The elongated tubercles, situated at each side of the siphonal zone (which latter becomes almost smooth towards the end of the shell) are small on the septate portion, but 4 mm. high and very sharp, where preserved on the last whorl. There is only one untuberculate intermediate rib here and there, as on the last whorl of *D. ? stevensoni*, but the bituberculation is rather irregular as regards spacing.

The suture line shows good agreement with that of *Didymoceras tortum*, Meek sp.,‡ except that the latter, taken at a larger diameter, shows correspondingly greater complication. There is the same high external lobe; only in the present form the siphonal line lies between the two rows of tubercles, which are placed more centrally. The principal lateral lobe shows a similar smaller outer and larger inner branch; the lateral saddle is equally bifid, the smaller second lateral lobe is bifid in the two forms, and the arrangement of the dorsal lobe and saddles is very similar. In *D. ? stevensoni*, the very complex suture-line, taken at a much larger diameter, shows a different development of the principal lobe, the outer branch being the larger. The suture-line of *D. pauper* (Whitfield) also is very similar to that here figured, and the whorl-section agrees, but the costation is different.

*D. horobyense*, Whiteaves sp.,§ a form somewhat resembling *D. ? binodosum*, Hauer sp.,|| is much more finely costate than the specimen here described, to judge by an example from Vancouver Island in the British Museum,¶ and other specimens of *Didymoceras* in the same collection from the Upper Missouri, etc., differ in the same respect.

\* *Loc. cit.* (1892), pl. xlv, fig. 3.

† *Ibid.*, pl. xlv, fig. 10.

‡ *Loc. cit.* (1876), p. 481, pl. xxii, fig. 4 c.

§ *Loc. cit.* (Mesoz. Foss. I), p. 332, pl. xlii, figs. 1-4.

|| "Neue Ceph. a. d. Gosangeb. d. Alp.," 'Sitz. B. K. Akad. Wiss.,' vol. liii (1866), p. 8, pl. i, fig. 6. This, however, may be a *Bostrychoceras*.

¶ This was labelled by Kossmat "*Heteroceras* sp. aff. *cooperi*, Meek," whereas another example of a *Didymoceras*, corresponding somewhat to Whiteaves' *A. cooperi* (*loc. cit.*, pl. xliii, fig. 1), but not with Meek's specimen or Gabb's fragment (the latter compared with *Emperoceras* by Hyatt, *loc. cit.*, p. 576), was wrongly labelled by Kossmat "*Acanthoceras vancouverensis*, Meek." In form and costation this second fragment recalls *D. ? conradi* (Morton), Whitfield sp., and *Emperoceras simplicostatum*, Whitfield sp., but there is also a striking resemblance of the looped tubercles with the ornament of *Jacobites anderssoni*, Kilian and Reboul (*loc. cit.*, 1909, p. 35, pl. viii, fig. 3).

On the other hand, there is a superficial resemblance to certain Albian *Turrilites*, e. g., *T. circumtaeuiatus*, Kossmat,\* or *T. catenatus* (d'Orbigny),† but not to Cenomanian species. The suture-line, however, is placed differently in these true *Turrilites*, and in the writer's opinion the *Nostoceratidae* cannot be considered to be descendants of the earlier *Turrilitidae*. The grouping of the uncoiled forms of the Senonian may be provisional and more or less unsatisfactory in the present state of our knowledge; but we must reject Nowak's‡ opinion that the Senonian "*Heteroceras*" ("*Helicoceras*" is a strictly Albian development), can, with the Aptian true *Heteroceras*, be considered to belong to one branch of uncoiled Parahoplitids.

*Locality*.—Umfolozi Valley, East of Railway. Coll. Mr. Illingworth.

### GEN. BOSTRYCHOCERAS, Hyatt.

#### 14. BOSTRYCHOCERAS? sp. nov.

1906. *Heteroceras* sp. Woods: "Cret. Fauna of Pondoland." Ann. S. Afr. Mus., vol. iv, part vii; No. 12, p. 339, pl. xlii, fig. 5 a, b.

This form is represented in the collection by several fragments. One of these (No. 5477) about 35 mm. in length, with almost circular cross-section (long and short diameters 12 mm. and 11.5 mm. respectively) corresponds with the figured example: another larger fragment of 16 mm. diameter and about 40 mm. length (No. 5476), like the impression of a third and still larger example (No. 5477A), appear to have some of the ribs more pronounced than others, so that it would seem as though, at a larger diameter, this form develops costation like that of the *Bostrychoceras* sp. ind. next described and compared with certain flared Japanese forms. The ribbing of the examples under discussion, however, is of quite a peculiar character. The inner shell, like the cast of the interior, only shows very indistinct costation. The second layer forms a broad and flat septum at the base of each rib and slight concavities in between these septa. The

\* *Loc. cit.* (1895), p. 141, pl. xviii, figs. 4 and 5. Kossmat renamed Stoliczka's *Turrilites brazoensis*, since it does not agree with Roemer's type, which Kossmat considered to be Lower Senonian. Whether Kossmat's example (p. 142 (46), pl. xx, fig. 4), agrees with the quadrituberculate Texas species may be doubtful, but *Turrilites brazoensis* is a true Cenomanian *Turrilites*, occurring in the Upper Denison Beds (Grayson Formation), about 200-300 ft. above the horizon of *Subschloenbachia lconensis*, probably of *rostrata* (s.l.) date. (R. T. Hill, "Geogr. and Geol. Black and Grand Prairies, Texas," '21st Ann. Rep. U.S. Geol. S.' (1901), p. 247).

† 'Pal. Franç., Ter. Crét.,' vol. i, pl. cxi, figs. 1-3.

‡ *Loc. cit.* (1913), p. 379.

third layer is very thin between the ribs, but apparently continuous with the material deposited on the rib-bases and forming comparatively high and very sharp ridges, and the whole is covered by a fourth outer layer of shell. Where the acute costation is worn off, the septate rib-bases show as illustrated in Wood's fig. 5 a.

Woods compared the form with Stoliczka's *Heteroceras indicum*, which is considered by various writers to be identical with, or closely allied to, *Bostrychoceras polyplacum*, Römer sp., but which, like *Turrilites saxonicus*, Schlüter, may be a *Hyphantoceras*, not a *Bostrychoceras*. On the other hand, the small constricted specimen figured as *Helicoceras indicum*? by Anderson\* and which is not identical with the Indian species, shows open coiling similar to the South African form, but it also may be a *Hyphantoceras*.

Of the many forms included in *Bostrychoceras polyplacum* (Römer) by Schlüter,† that figured on pl. xxxv, fig. 8, or the evolute form figured by Geinitz‡ may belong to species allied to the South African examples. *B. ? declive*, Gabb sp.,§ *B. japonicum*, Yabe sp.,|| further, the whorl-fragments figured by Jimbo¶ as "*Turrilites* sp." and by Meek\*\*

\* "Cret. Depos. of the Pacific Coast," 'Proc. Calif. Acad. Sci.,' 3rd ser., Geol. II, i, p. 91, pl. iii, figs. 96 and 97.

† A specimen of a *Bostrychoceras* sp. n., in the British Museum (No. 74042) from Haldem in Westphalia, comparable with Schlüter's pl. xxxiii, figs. 6 and 8, from the same locality (*Heteroceras polyplacum* (A. Römer) in Schlüter) has a costate early portion, then a constriction, and a bituberculate final portion. This form and, perhaps, more so Schlüter's fig. 1 of pl. xxxiv, then *Bostrychoceras ? carlottensis*, Whiteaves sp. (*loc. cit.*, p. 271, pl. xxxiv, fig. 1) and *B. ? oshimai*, Yabe sp. (*loc. cit.*, 1904, p. 12, pl. iii, figs. 5 and 6, which, however, may be a *Hyphantoceras*), show close resemblance in ornamentation to certain *Didymoceras*, e.g. *D. nebrascense*, Meek sp. (B.M. No. 83907 from Upper Missouri), and *D. hornbyense*, Whiteaves (B.M., Hector Collection from Vancouver Island). The separation of fragmentary examples of the two genera *Bostrychoceras* and *Didymoceras*, based only on tuberculation and mode of coiling, seems somewhat artificial, as a comparison of such typical forms of *Didymoceras* (in Hyatt) as *D. cochleatum* and *D. tortum*, Meek sp., with some of the tuberculate varieties of *B. polyplacum* in Schlüter will demonstrate. The suture-lines, also, are of a similar pattern in the whole family *Nostoceratidæ*.

‡ "Das Elbthal-Geb. i. Sachsen," II, 'Palæontogr.,' vol. xx (1872-5), p. 195, pl. xxxvi, fig. 3 only. (" *Turrilites polyplacus* var. of *Helicoceras* type.")

§ 'Pal. of California,' vol. i, p. 73, pl. xxviii, figs. 200, 200 a. Upper Chico in Anderson, *loc. cit.* (1902), p. 27, Maestrichtian in Hang, 'Traité,' p. 1347.

|| "Cret. Ceph. from the Hokkaido," 'Jl. Coll. Sci. Imp. Univ. Tokyo,' vol. xx (1904), p. 17, pl. iii, fig. 8.

¶ "Beitr. z. Kenntn. d. Kreidef. v. Hokkaido," 'Pal. Abh.,' vol. vi (1894), p. 41, pl. i, fig. 8.

\*\* *Loc. cit.* (1876), pl. xxi, fig. 4.

as "*Heteroceras*? sp. ind.," agree with the specimens here described in whorl-shape and coiling, but all have oblique costation.

A fragment of a "*Heteroceras* sp.," from the "Iron Mines of Hokkaido, Japan" (B.M., No. C10410B) resembles the South African form in coiling and whorl-section, and being a cast, in the faint ribbing, but it is considerably larger. Its suture-line is "lytoceratid," like that of *Pravitoceras sigmoidale*, Yabe,\* which it closely resembles, and it is associated with fragments comparable with the inner, closely coiled whorls of *Pravitoceras*† and with the terminal portion of such a species of *Bostrychoceras* or *Didymoceras*, as, e. g., the variety of "*Heteroceras polyplocus*" figured by Schlüter on pl. xxxiv, figs. 2 and 3, or *D.?* *cooperi*, Gabb, in Whiteaves.‡ The age of *Pravitoceras* unfortunately is not known, but it is to be noted that the suture-line of the South African form, figured by Woods, and that of the Turonian *Hyphantoceras*, are very similar to that of *Pravitoceras*, and the writer is of opinion that the resemblance of all these to the suture-line of *Lytoceratidae* is a case of convergence, correlated with the rounded whorl-shape. *Nipponites*§ also represents a development related to the loosely-coiled *Bostrychoceras* here discussed, but the reference of the South African form to this genus cannot, of course, be considered definite so long as only fragmentary specimens are available. The young of *Emperoceras*|| show hamitid, helicoid coiling, and the twisted form figured by Woods¶ as *Hamites* (*Anisoceras*), sp., seems to form a transition to such species as "*Ancyloceras*" *retrosum*, Schlüter, and to the group of "*Anisoceras*" referred to in the description of *Diplomoceras? indicum*, which groups stand in the same relationship to *Bostrychoceras* as (ptychoceratid, hamitid or ancyloceratid) *Oxybeloceras*\*\* does to *Exiteloceras*. The similarity, however, of the

\* "Note on Three Upper Cretaceous Ammonites etc.," 'Jl. Geol. Soc. Tokyo,' vol. ix (1902), No. 100, p. 3, pl. i, figs. 2-4.

† *Ibid.*, fig. 3.

‡ *Loc. cit.*, p. 336, pl. xliii, fig. 1.

§ Yabe, *loc. cit.* (1904), p. 20, pl. iv, figs. 4, 7, pl. vi, fig. 6.

|| Hyatt, *loc. cit.* (1894), p. 575, pl. xiv, figs. 15-17.

¶ *Loc. cit.*, p. 340, pl. xlv, fig. 3.

\*\* Unless new genera are introduced again for the different forms of coiling, such species as "*Hamites*" *wernickei*, Wollemani ("Fauna d. Lüneburger Kreide," 'Abh. K. Preuss. L. A.,' n.f., Heft. 37 (1902), p. 95, pl. iv, fig. 4, and pl. v, figs. 1 and 2—crushed?), or "*Ancyloceras*" *bipunctatum*, Schlüter (*loc. cit.*, p. 98, pl. xxix, figs. 1-3), will have to be included in *Oxybeloceras*, whereas "*Crioceras*" *plicatilis*, Kner, non Sowerby (Lemberg, 'Naturw. Abh.,' iii, 1850, pt. 2, p. 9, pl. ii, fig. 3) = *Helicoceras schloenbachi*, Favre ('Moll. Craie, Lemberg,' 1869, p. 30, pl. vii, figs. 5 a c), and *Helicoceras hibernicum*, Tate, possibly belong to *Exiteloceras*. The presence of at least one other unnamed group is indicated by

young of *Emperoceras simplicostatum*, Whitfield sp., to *Oxybeloceras* shows that the interrelations of these genera are very complicated, and that the determination of mere fragments is very difficult.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

### 15. *BOSTRYCHOCERAS?* sp. ind.

(Pl. XXIV, fig. 2.)

An impression (No. 5478A) of a whorl-fragment of a form allied to the *Heteroceras* sp., figured by Woods\* but with only three, not four, intermediate ribs and the flares much closer together, is doubtfully referred to the genus *Bostrychoceras*. In a length of about 40 mm. there are six of these flares, as against four in the Pondoland example. This closeness of the costation approaches the form to "*Helicoceras* (?)" *venustum*, Yabe† and "*Helicoceras*" *scalare*, Yabe,‡ but these have more numerous intermediary ribs and may possibly belong to *Hyphantoceras*. The peripheral portion of the impression here described, and its whorl-section being unknown, comparison with "*Helicoceras*" *breweri*, Gabl,§ and "*Crioceras* (?)" *cingulatum*, Schlüter,|| is difficult. They also represent similar fragments with flares, apparently connected with the typical *Bostrychoceras* by such forms as *B. japonicum*, Yabe sp.¶

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit. (Impression in matrix of specimen 5478 = *Diaziceras tissotiaeforme*, nov.)

such forms as "*Hamites*" *phaleratus*, Griepenkerl ("Verstein. d. Senon. Kreide v. Königsutter," 'Pal. Abh.,' vol. iv (1889), Heft 5, p. 104, pl. xi, fig. 3, and pl. xii, figs. 3 and 4), "*Ancyloceras*" *pseudo-armatum*, Schlüter (*loc. cit.*, p. 164, pl. xliii, figs. 8 and 9, ? 5-7), and "*Ancyloceras*" *kossmati*, Simionescu ("Fauna Cret. Sup. d. l. Ürmös.," 'Acad. Romana,' Publ. Fd. Vasilie Adamachi, No. 4 (1899), p. 21, pl. i, figs. 6-8). A beautiful, but fragmentary, example of a new form of this group, comparable with "*Hamites*" *quadrinodosus*, Jimbo sp., from the Umzamba beds of Pondoland (Coll. Geol. Survey), was sent to the writer, after the completion of this paper, through the kindness of Mr. Henry Woods. The Durban Museum Collection, already referred to, also includes *Oxybeloceras* ? sp., cf. *interruptum*, Schlüter, and *wernickei*, Wollemann sp.; further, several gen. nov. (*Hyphantoceras* ?) cf. *spinigerum*, Jimbo sp., all from the Pondoland Senonian.

\* *Loc. cit.* (1906), p. 339, pl. xlii, fig. 4.

† *Loc. cit.* (1904), p. 11, pl. iii, fig. 4.

‡ *Ibid.*, p. 9, pl. iii, figs. 2 and 3.

§ *Loc. cit.*, vol. i, p. 72, pl. xiv, fig. 22 (Upper Chico in Anderson, p. 27).

|| *Loc. cit.*, p. 101, pl. xxx, figs. 13 and 14.

¶ *Loc. cit.*, p. 17, pl. iii, fig. 8.

## GEN. DIPLOMOCERAS, Hyatt.

## 16. DIPLOMOCERAS? INDICUM, Forbes sp.

(Pl. XXIII, fig. 5.)

1895. *Hamites (Anisoceras) indicus*, Forbes. Kossmat. Südind. Kreidef. Beitr. z. Pal. und Geol. Öst.-Ung. etc., vol. ix, p. 145, pl. xix, fig. 4.
1906. *Hamites (Anisoceras) indicus*, Woods. Cret. Fauna of Pondoland, p. 340, pl. xlv, fig. 2.

This form is represented in the collection by a fragment (No. 5465) that corresponds with Kossmat's fig. 4*a*; but the hooked portion forms the smaller end, not the larger, as in Kossmat's figured example. The last few suture-lines, shown on the hooked portion of the shell, are of the general outline of that of *D. ? indicum* as figured by Kossmat, but have a less minutely frilled edge. The costation is closer than it is in the fragment figured by Woods, but not so close as in Kossmat's specimen or in *D. ? rugatum* (Forbes), Kossmat sp., the cross-section of which latter species, also, is more elliptical. The costation is very sharp and not septate, *i. e.* the ribs are as acute on the cast as they are on the shell. One of the ribs is higher than the others (about 1.5 mm. high, measured from the concavity at each side, at a whorl-diameter of 9 mm.). Specimens of *D. ? large-sulcatum*, Forbes sp., and *D. ? rugatum*, Forbes sp., in the British Museum show similar irregularities, as does the Japanese form, figured as "*Hamites* sp.," by Jimbo\* and compared with *D. ? large-sulcatum* by Kossmat.† The costation is too distant, however, in the latter species, as it is in the small fragment of a "*Hamites*" from Umkwelane Hill figured by Etheridge.‡ This was compared with Griesbach's *Anisoceras rugatum*, Forbes sp., from the Umtamvuna Beds (a form that was included by Woods in the synonymy of *D. ? indicum*), but probably is nearer to *D. ? large-sulcatum*, Forbes sp.

Such species as *D. obstrictum* Jimbo sp.,§ and *D. ellipticum*, Anderson sp.,|| seem to form a connection with the typical gigantic *Diplomoceras* of the *cylindricum* and *notabile* group, but with increased knowledge of these forms it will probably be necessary to separate from the highly specialised *Diplomoceras* the Indian "*Anisoceras*"

\* *Loc. cit.* (1894), p. 40, pl. vii, fig. 7.† *Loc. cit.* (1895), p. 147.‡ *Loc. cit.* (Second Report, 1904), p. 90, pl. iii, fig. 23.§ In Whiteaves, *loc. cit.*, p. 334, pl. xlv, fig. 3.|| *Loc. cit.*, 1902, p. 87, pl. iii, figs. 102-3.



assemblage on the one hand, which connects directly with the loosely coiled *Bostryhoceras* above described, and on the other the various European "*Hamites*" ("*H. roemeri*, Geinitz), "*Toroceras*" (*T. aquisgranensis*, Schlüter), "*Ancyloceras*" (*A. retrorsum*, Schlüter) of slightly earlier date and simple suture-line. Whether these Campanian "*Hamitids*" are ancestral to the Maestrichtian *Diplomoceras* and what their relationship is to the contemporaneous "*Ptychoceras*" and *Solenoceras* it is for future investigation to determine. It may be added that a form indistinguishable from the Maestrichtian *Diplomoceras cylindricum*, d'Orbigny sp., occurs in the Cambridge Greensand (Uppermost Albian), but the writer is convinced that this is only a case of convergence, and that even the Turonian "*Hamitids*" should be separated generically from the Senonian forms. The last true *Hamites* are comparatively rare in the Cenomanian.

*Locality*.—Unkwelane Hill. Coll. Dr. A. L. du Toit.

## FAMILY: BACULITIDÆ.

GEN. BACULITES, Lamarek.

### 17. BACULITES CAPENSIS, H. Woods.

(Pl. XXIV, figs. 6 and 7.)

1906. *Baculites capensis*, Woods. "Cret. Fauna of Pondoland," Ann.

S. Afr. Mus., vol. iv, part vii, No. 12, p. 342, pl. xlv, figs. 6 and 7.

? 1907. *Baculites vagina*, Forbes in Boule, Lemoine & Thévenin.

"Céph. Crét. Diego-Suarez," Ann. de Pal., vol. ii, p. 65, pl. xv, fig. 3.

This is the commonest cephalopod at Unkwelane Hill, sixteen examples being referred to this species, in addition to a number of fragments in the matrix of other fossils. The young is merely striate, like *B. bailyi*, and the nodes first appear where the long diameter is about 8 mm.

Woods compares the species with *B. asper* as figured by Morton, Römer and Stanton, the last probably of Turonian age. The less coarsely nodate form figured by Meek,\* and a specimen of this in the British Museum from "*Mississippi*" are very close to the South African species in all characters but the suture-line.

Some of the larger examples (No. 5479A, 5403) seem to develop coarser striation on the siphonal side, much like the example here compared with *B. sulcatus*, Baily. The suture-line differs rather

\* *Loc. cit.* (1876), p. 404, pl. xxxix, fig. 10 a only.

considerably from that of *B. incurvatus*, Dujardin,\* and is closer to that of *B. fairbanksi*, Anderson,† characterised by broad and low saddles and small lobes. *B. vagina*, Forbes, has an entirely different suture-line ‡; and in that of the probably Turonian *B. gracilis*, Shumard, in Stanton,§ which also is comparatively simple, the lateral saddle is too high and too narrow, and the second lateral lobe too deep. On the other hand, the suture-line figured by Boule, Lemoine and Thévenin || as that of *Cyrtocheilus baculoides*, Mantell sp., agrees very well with that of the South African species, and that of *B. bohemicus*, Fritsch and Schloenbach, ¶ also is very similar.\*\*

The form figured by Boule, Lemoine and Thévenin †† as *Baculites vagina* (Forbes), var. *otacodensis* Kossmat, seems to agree much more with Woods' species than with the Indian form.

*Localities*.—Nos. 5479, 5443, 5490, 5454, 5470, 5458, 5474, 5484 (pars), 5486, 5408, 5475, 5479A and 5403 from Umkwelane Hill. Coll. Dr. A. L. du Toit. No. 4832 from Railway Cutting, Umfolozi. Coll. W. J. Wybergh. No. 5108 from Umkwelane Hill. Coll. J. S. Hedges.

#### 18. *BACULITES* sp. aff. *CAPENSIS*, H. Woods.

A number of poorly preserved specimens (5484 (pars), 5479B, 5509B) are comparable with the fragment figured by Etheridge ‡‡ from Umkwe-

\* In Schlüter (after Geinitz), *loc. cit.* pl. xl, fig. 3.

† *Loc. cit.* (1902), fig. 194, pl. x, p. 92.

‡ The suture-line in Steinmann (Quiriquina, *loc. cit.*, 1895, p. 91, text-fig. 8), is different from that of Forbes' type (B.M. No. R10488, Geol. Soc. Coll.) and of Indian specimens in the writer's collection.

§ *Loc. cit.* (Col. Form., 1893), p. 166, pl. xxxvi, fig. 2. See also Solger (*loc. cit.*, Kamerun, 1904), text-fig. 4, on p. 102.

|| *Loc. cit.*, II (1907), text-fig. 29, on p. 65.

¶ In Schlüter, *loc. cit.* ii, 1876, fig. 5 on pl. xxxix.

\*\* The suture-lines of the varieties *valognensis* and *leopoliensis* of *B. anceps* (Nowak, "Untersuch. Poln. Kreide," 1, *Baculites*, 'Bull. Ac. Sci. Cracovie,' 1908, p. 331, text-figs. 1-4 and 5-10) are of the same type, but with a more complex ventral lobe. The suture-line (drawn by the late G. C. Crick) of a Pondoland example (B.M., No. C19420), represented in fig. 7 of Pl. XXIV, is characterised by a wider inferior lateral lobe than that of the specimen 5486, here figured (Pl. XXIV, fig. 6). On the other hand, the very similar suture-line of *B. oberholzeri*, Böhm (in Böhm and Heim, "Senonbild. d. Ö. Schweiz. Alp.," 'Abh. Schw. Pal. Ges.,' vol. xxxvi (1909), p. 52, pl. i, fig. 9), varies in just the opposite direction. The minute *B. n. sp.* in Jahn ('Beitr. z. Kenntn. d. Böhm. Kreide. Jb. K.K.E.A.,' vol. xlv [1895], p. 136, pl. viii, figs. 8 a-c) has a suture-line very similar to that of the Pondoland example, but the lobes are not clearly bifid.

†† *Loc. cit.* (1906), p. 65, pl. xv, fig. 3.

‡‡ *Loc. cit.* (1904), p. 90, pl. iii, fig. 24.

lane Hill. They probably belong to Woods' species in spite of the apparent absence of nodes, though this lack of ornament suggests affinity with *B. bailyi*, Woods (which apparently is rare, and characterised by a very distinct type of suture-line), or with other smooth species of *Baculites*.

The examples that Crick\* records from the South Branch of the Manuan Creek, apparently related to *B. capensis*, Woods, are similarly poorly preserved and more or less indeterminable specimens.

Specimen No. 5484, containing at least twenty to thirty examples, has in addition to *B. capensis*, and forms close to *B. bailyi*, a number of more or less unidentifiable fragments that had best be included here. One example has the mouth border complete, but no initial whorls were discovered in this block, the reason being, perhaps, that this coarsely sandy, conglomeratic matrix (with pebbles of fossil wood) was not suitable for the preservation of so delicate a structure. The mode of life in the embryonic stage, also, possibly was different (planctonic?) from the mud-boring existence of the adult shells.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

#### 19. BACULITES cf. ASPERO-ANCEPS, Lasswitz.

(Pl. XXIV, figs. 4, 4a.)

1852. *Baculites anceps*, Lamarek. Römer, Kreidebild. v. Texas, etc., p. 36, pl. ii, figs. 3b and c only.

1904. *Baculites aspero-anceps*, Lasswitz. "Kreide-Amm. v. Texas," Geol. und Pal. Abh., vol. x, 4, p. 16, pl. iii (xv), figs. 1a and b.

A small portion of a *Baculites* (No. 5480), 38 mm. in length and forming part of the body-chamber, differs from the many examples of *B. capensis* that occur in the same rock, merely in having the nodes closer, there being six in the length represented, as against half as many in Woods' species. The nodes are rounded, as in *B. capensis*, and the cross-section also, perhaps, resembles that of *B. asper*, Morton (in Römer), and of *B. capensis* more than it does that of *B. aspero-anceps*. The form here described probably is only a variety of *B. capensis*, comparable to the Texas form in the closer spacing of the nodes. It may be added that some of the examples included in *B. capensis* (e. g. No. 5490, and No. 5470) have the nodes closer than the (larger) Pondoland examples, and thus are transitional to the form here described.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

\* *Loc. cit.* (1907), p. 240.

## 20. BACULITES cf. BREVICOSTA, Schlüter.

(Pl. XXIV, figs. 5, 5 a.)

1876. *Baculites brevicosta*, Schlüter. "Cephal. d. Ob. Deutsch. Kreide," Palaeontogr., vol. xxiv, p. 141, pl. xxxix, figs. 9 and 10.  
 [Non 1885. *Baculites brevicosta*, Schlüter, in Moberg, *loc. cit.*, p. 37, pl. iv, figs. 5 and 6.]

One example (No. 5461), showing nine nodes in a length of about 30 mm., apparently agrees with Schlüter's species, but it is not definitely identified with the species of the Emscher marls, since it probably only represents a variety of *B. capensis*; that is to say, its exact agreement with Schlüter's species\* may be a case of heterochronous homocomorphy. The suture-line agrees with that of *B. capensis*, and differs from that of *B. anceps* as figured by d'Orbigny† in having the two lateral lobes much narrower, and in having the siphonal portion of the ventral saddle smaller than the internal branch, an arrangement also seen in a specimen of *B. incurvatus*, Dujardin, in the writer's collection. The suture-line of *B. anceps*? figured in Schlüter‡ also has a comparatively large second lateral lobe. What Schlüter states to be observable in the type of *B. brevicosta*, namely, "saddles that are considerably broader than the lobes, and inferior lateral lobes that lie almost completely on the anti-siphonal side," agrees with the characters of the suture-line of the Zululand form. *B. fairbanksi*, Anderson,§ though differing in ornament, has the same type of suture-line as *B. capensis* and *B. cf. brevicosta*, but with a more minutely frilled edge.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

## 21. BACULITES sp. cf. SULCATUS, Baily.

1906. *Baculites sulcatus*, Baily. Woods, "Cret. Fauna of Pondoland," Ann. S. Afr. Mus., vol. iv, part vii, No. 12, p. 341, pl. xlv, fig. 4.

One terminal fragment of a larger specimen (No. 5467), characterised by the absence of nodes, is striated like Baily's species, but the

\* Wegner (in "Die Granulat. Kreide. d. Westl. Münsterland," Zeit. Deutsch. Geol. Ges., vol. lvii (1905), pp. 207 and 228), who records this species from the zone of *Inoceramus cardissoides*, states that the nodes ("ribs") are crescent-shaped, whereas in the present example they are rounded like those of *B. capensis*.

† Pal. Franç. Ter. Crét., 1 (1840), p. 565, pl. cxxxix, fig. 7.

‡ *Loc. cit.* (1876), pl. xl, fig. 6.

§ *Loc. cit.*, p. 92, pl. vii, figs. 152 and 153, and pl. x, fig. 194.

folds are not so coarse as they are in Baily's original fig. 5 *c*, selected as type of the species by Woods. Also, whereas in Baily's holotype (No. 11373, Geol. Soc. Coll., British Museum), and still more so in the co-type, the folds are coarser on the dorsal than on the ventral sides, the reverse is noticeable in the present example, so that the latter may only be a variety of *B. capensis*, Woods, resembling some of the larger examples mentioned under the description of that species.

*B. cariuatus*, Binkhorst,\* has a somewhat similar ventral aspect, but in the specimen here described, the whorl section is elliptical and evenly rounded.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

## 22. BACULITES BAILYI, H. Woods.

1906. *Baculites bailyi*, Woods. "Cret. Fauna of Pondoland," Ann. S. Afr. Mus., vol. iv, part vii, No. 12, p. 341.

Three fragments (No. 5463) agree with Baily's original specimen† and have merely fine striation, not nodes, agreeing in this respect with *B. faujasi*, Lamarek, in Binkhorst‡ = *B. vertebralis*, Montfort (§), and with the large forms, *B. oratus*, Say, and *B. grandis*, Hall and Meek. *B. chicoensis* (Trask), Gabb,§ a number of specimens of which from Vancouver Island are in the British Museum, has only a slightly different suture-line and altogether seems very close.

*B. syriacus*, Conrad, according to a number of more or less badly-preserved specimens in the Egyptian Collection at the British Museum, referred to below (and associated with *B. cf. teres*, Forbes, and *B. cf. leopoliensis*, Nowak), probably also represents a similar smooth form of this group.

*Locality*.—Umkwelane Hill. Coll. Dr. A. L. du Toit.

\* *Loc. cit.* (1861), Ceph., p. 43, pl. v *d*, fig. 2.

† 'Q. J. G. S.' vol. xi (1855), pl. xi, fig. 5 *a, b* (non 5 *c*), B.M. (Geol. Soc. Coll.), No. 11372.

‡ *Loc. cit.* (1861), p. 40, pl. v *d*, fig. 1. The suture-line differs only in the width of the dorsal saddle.

§ *Loc. cit.* (vol. i), p. 80, pl. xvii, fig. 27 *a*, and pl. xiv, fig. 27 *b* ("commonest form, having few or no ribs"). Meek (*loc. cit.*, 1876, Bull. ii, p. 364), includes in the synonymy of *B. chicoensis*, Trask, his own *B. inornatus*, and Whiteaves ('Mesoz. Foss.' 1903, p. 339) also includes in Trask's species Meek's *B. occidentalis*.

## B. NAUTILOIDEA.

### GEN. EUTREPHOCERAS, Hyatt.

#### 23. EUTREPHOCERAS aff. DEKAYI, Morton sp.

1907. *Nautilus dekayi* (Morton). Stuart-Weller, Report on Cret. Pal. of New Jersey, vol. iv (Pal. Ser.), Geol. Surv., N.J., p. 817, pl. c., figs. 2-5.
1910. *Nautilus dekayi* (Morton), Spengler. "Untersuch. ü. d. Südind. Kreideform. Pt. iv: Die Nautil. und Bel. d. Trichinopoly Distr.," Beitr. z. Pal. und Geol. Öst.-Ung., vol. xxiii, pt. iii, p. 137.

A small and poorly preserved specimen (No. 2751), of a little over 40 mm. in diameter, and of equal thickness, seems to agree with the typical figures cited above, and with specimens of this form from the Fort Pierre Shale, Black Hills, South Dakota, U.S.A., in the writer's collection. Since, however, the present example is somewhat crushed, so that the original shape of the whorl-section cannot accurately be determined, the specific identification must remain doubtful.

The position of the siphuncle (centran) corresponds with that shown in Fig. 4 of the reference given above, and not with that of fig. 1 a in Meek\* (dorsocentran). Spengler gives the thickness as 90-100 per cent. (typically 92 per cent.), which agrees with that of the specimen here described. There does not appear to be an annular lobe.

*Eutrephoceras ovoideus*, G. C. Crick sp.,† probably an older (Cenomanian) species, has a more elevated, less depressed whorl section. *Nautilus* [*Cymatoceras*?] *occlusus*, G. C. Crick,‡ has a similar globose, though less depressed, whorl-shape, but the position of the siphuncle is centroventran, and there is an annular lobe—at least in the young. Since the Senonian also occurs at the North-West end of False Bay, it is impossible to state whether the six examples described by Crick are all of the same (Cenomanian) age, or even whether they are identical or co-generic, without breaking them up.

The Antarctic example of *Nautilus blanfordianus*, Kilian and Reboul,§

\* "Report Invertebr. Cret. and Tert. Foss. Up. Missouri Country," in Hayden, 'U.S. Geol. Surv. of Territ.,' vol. ix (1876), p. 496, pl. xxvii.

† *Loc. cit.* (1907), p. 222, B.M., No. C18253-6.

‡ *Ibid.*, p. 224, B.M., No. C18257-62.

§ "Les Céph. Néocrét. d. Îles Seymour et Snow Hill," 'Wiss. Ergeb. Schwed. Südpol. Exped.,' vol. iii, pt. vi (1909), p. 8, pl. i, figs. 1 and 2.



represents a very similar form of *Eutrephoceras* to the specimen here described, with the thickness about equal to the diameter, but the siphuncle is ventrocentran in the Antarctic form, as it is in the far less depressed *N. husleyanus*, Blanford.

*Locality*.—Umfolozi Valley, East of Railway. Coll. J. L. Illingworth.

24. *EUTREPHOCERAS* cf. *SUBLAEVIGATUM* (d'Orbigny) var. *INDICA*  
(Spengler).

1861. *Nautilus bouchardianus*, d'Orbigny. Blanford, Cret. Fauna S. India (Pal. Indica), vol. i, "Cephalop.," pl. v, fig. 3.

1910. *Nautilus sublaevigatus* var. *indica*, Spengler. "Untersuch. ü. d. Süd-Ind. Kreideform. Pt. iv. Die Nautil. und Bel. d. Trichinopoly Distr.," Beitr. z. Pal. und Geol. Öst-Ung., vol. xxiii, pt. iii, p. 137.

A nearly complete but slightly weathered example of a *Nautilus* (No. 5509) agrees well in proportions with the large specimen figured by Woods,\* and at a diameter of 150 mm. has a thickness of 110–115 mm. The sides and ventral area, however, are more flattened (weathered?), giving the whorl a more quadrate shape. The last half whorl of the specimen represents the body-chamber, with indications of a mouth-border at the end. Several specimens of *Baculites* are embedded in the matrix of this body-chamber.

Since the specimen was not broken up to reveal position of the siphuncle, presence of an annular lobe, etc., the identification with the Indian form of *N. sublaevigatus*, with which Woods also had compared his Pondoland example, must remain doubtful. It is based on similarity of whorl-shape and dimensions and general agreement with Blanford's fig. 3.

The probably Cenomanian *Eutrephoceras oroideum*, G. C. Crick sp.,† has a more elevated whorl-section, and *Nautilus* [*Cymatoceras*?] *occlusus*, G. C. Crick, is too inflated in the umbilical region.

Some of the *Nautilus* (*Eutrephoceras*) sp., described by Crick‡ from the South Branch of the Manuan Creek, Zululand, may belong to the present Senonian species.

*Locality*—Umkwelane Hill, Umfolozi, Zululand. Coll. Dr. A. L. du Toit.

\* *Loc. cit.* (1906), p. 330, text-fig. 1 on p. 331.

† *Loc. cit.* (1907), p. 222.

‡ *Loc. cit.* (1907), p. 245, B.M., Nos. C18292–5.

## GEN. CYMATOCERAS, Hyatt.

## 25. CYMATOCERAS? sp. juv. cf. VALUDAYURENSE, Blanford sp.

1861. *Nautilus valudayurensis*, Blanford. Cret. Fauna S. India (Pal. India), vol. i, "Cephalop.," p. 23, pl. xii, figs. 2-3.

1866. *Nautilus valudayurensis*, Stoliczka, *ibid.*, p. 206.

A small and fragmentary specimen (No. 5469), consisting of the casts of four camerae in a very good state of preservation, agrees with Blanford's figures, especially in the outline of the sectional view (fig. 3), in position of the siphuncle (centrodorsan), and the presence of a small annular lobe. The decussate ornament figured in 2*b* also is well shown in the dorsal impression, but on the outer whorl only striae of growth are visible, not the coarse folds typical of *Cymatoceras*. On the other hand, the presence of the linguiform annular lobe shows the specimen to be distinct from *Eutrephoceras*,\* some examples of which (e. g. *E. dekayi* (Morton), var. *mountanaense*, Meek†) agree with it in whorl-section. Of the various forms included by Spengler‡ in *Nautilus* [*Cymatoceras*] aff. *atlas*, Whiteaves, the small ammonite figured by Blanford§ somewhat resembles the fragment here described, but the siphuncle is ventrocentran in the Indian specimen, not centrodorsan.

The small *Nautilus* sp. described by Crick¶ has a similar septal surface, with annular lobe, but a more depressed section, and probably is of Albian age, as also is *Cymatoceras manuanense*, Crick sp.¶¶. The large examples of this species have no annular lobe, but agree in section and position of siphuncle.

*Locality*.—Umkwelane Hill, Umfolozi, Zululand. Coll. Dr. A. L. du Toit.

## OBSERVATIONS ON THE UMKWELANE HILL FAUNA.

To the Cephalopoda from Umkwelane Hill, described in the foregoing pages, must be added three Ammonoids recorded by Etheridge, namely :

*Placenticeras kaffrarium*, Etheridge.

„ *umkwelanense*, Etheridge.

*Diplomoceras*? cf. *large-sulcatum*, Forbes sp.

\* Hyatt, "Phylogeny of an Acquired Characteristic," 'Proc. Am. Philos. Soc.,' xxxii, No. 143, 1894, appendix, p. 555.

† *Loc. cit.* (1876), p. 498, pl. xxvii, figs. 2-2*f*.

‡ *Loc. cit.* (1910), p. 135.

§ *Loc. cit.* (1861), pl. viii, fig. 4.

¶ *Loc. cit.* (1907), p. 248, B.M., No. C18310.

¶¶ *Ibid.*, p. 243, pl. xv, fig. 6, B.M., Nos. C18282-5.

Further, the typical—

*Mortoniceras umkwelanense*, Crick,

so that up to the present twenty-nine species and varieties have been described from this locality.\* The form figured by Etheridge as "*Creniceras* (?) *sp. ind.*" is not included, since its systematic position is quite uncertain, and since it may not even be a cephalopod.

Woods and Newton considered the Umkwelane Hill fauna to be of the same age (Campanian) as that of Pondoland. The occurrence, at Umkwelane Hill, of a form (*Mortoniceras woodsi*, nov.) that is very close to *M. delawareense*, confirms the presence of the Campanian, and there certainly is no indication of any Cenomanian or "Vraconnian" admixture in this fauna, as suggested by Lemoine.† On the other hand, the Maestrichtian, or part of it, may also be represented in South Africa. *Parapachydiscus* of the *colligatus* type are quoted both from Campanian and Maestrichtian‡ deposits; and *Placenticeras umkwelanense*, compared by Etheridge with *P. placenta*, also the two Nostoceratids, recall Maestrichtian forms. According to Woods, *Pseudophyllites indra* occurs in the basement bed of the Pondoland deposit; and Haug calls the "*Anisoceras*" and *Trigonoarca* beds of the Valudayur group (with *Pseudophyllites indra*) Maestrichtian, but in the writer's opinion, the many large *Mortoniceras*, characteristic of South Africa, are pre-Maestrichtian.

The occurrence, in the Pondoland Collections, of these *Mortoniceras* in the same blocks with *Hanericeras gardeni* and with *Pseudoschloenbachia*, makes it probable that they are, indeed, Upper Senonian. De Grossouvre's contention that the Pondoland deposits are of Lower Senonian age and somewhere near the limit of the Coniacian and Santonian divisions has been questioned by Woods,§ who stated that "the probability that one zone only is represented is supported by the observations made by the Survey that most of the species range throughout the deposit, as well as by the small thickness of that deposit."

\* Newton (*loc. cit.*, p. 96) recorded the occurrence of a *Baculites*, closely resembling *B. bailyi*, Woods, in the matrix of an Umkwelane Hill specimen.

† 'Études Géol. dans le Nord de Madagascar,' Paris, 1906, p. 396. On this page Lemoine puts part of the Umkwelane Hill beds (with *Mortoniceras* and "*Anisoceras*") as equivalent to the Utatur beds of Southern India, but on p. 403 he classes the fauna, described by Etheridge, as Senonian, whereas in the table on p. 405 the former beds (with *Mortoniceras* and "*Anisoceras*") are, perhaps through a slip, included in the Turonian.

‡ The specimen here described as *P. n. sp. aff. colligatus* shows very good agreement with a typical French example (B.M., No. C524), except that it is thicker.

§ *Loc. cit.* (1906), p. 346.

At Umkwelane Hill, as in Pondoland, it is chiefly the resemblance of the *Mortoniceras* to *M. texanum*, and of *Pseudoschloenbachia* to Grossouvre's Coniacian-Santonian forms that suggests the presence of pre-Campanian horizons.

The additional evidence, however, is not very satisfactory so far as exact dating of the beds within the Senonian is concerned; and it is hardly safe, from the evidence available, to assume the complete absence of pre-Campanian horizons at Umkwelane Hill. *Placenticerus subkaffrarium*, nov., is close to *Pl. tamulicum*, Kossmat, which occurs in the Upper Trichinopoly group of India; and at the Manuan Creek, this new form, or a close ally, is associated with *Kosmaticeras* (*Madrasites*) *bhavani*, Stoliczka sp., also common to the Upper Trichinopoly and the Aryalur groups. Now the former group includes *Peroniceras dravidicum*, Kossmat sp., which is here described from the junction of the Manuan and Umsinene Rivers, whereas two other forms of *Peroniceras* (*P. cf. czörnigi*, Redtenbacher sp., and *P. cf. rousseauxi*, Grossouvre) were included in the collection described by the late G. C. Crick. The presence of the Coniacian in Zululand is thus established.

Again, the new genus *Diazicerus*, the type-specimen of which is associated in the same block with *Bostrychoceras* ? *sp. ind.*, a form that is comparable with certain Upper Senonian types of the Hokkaido and of California, is here considered to be related to *Pseudoschloenbachia papillata* from Pondoland, but in suture-line the new genus is very close to *Lenticeras andii*, Gabb sp., or *L. baltai*, Lisson, whereas "*Barroisicerus*" *desmoulini*, Grossouvre sp., resembles it very much in external characters. Both these genera are of Lower Senonian age; *Barroisicerus* occurs associated with *Peroniceras* in Madagascar and the Cameroons; *Lenticeras* is associated with *Mortoniceras texanum* in South America.

It may also be pointed out that the new collection of Pondoland fossils belonging to the Durban Museum, and referred to in the introductory part of this paper, contains "*Puzosia*" *sugata*, Forbes sp., and an Ammonite resembling the Madagascar example of "*B. habberfellneri* (Hauer)," figured by Boule, Lemoine and Thévenin.\* This new form may, perhaps, be more nearly related to certain Upper Chico types, e. g. "*Schloenbachia*" *chicoensis* (Trask), Anderson,† though similar "*Barroisicerus*" also occur in the Lower Chico formation, but are not satisfactorily separated from numerous forms that may be true *Prionocyclus*. "*Puzosia*" *sugata*, also, is recorded from the Lower Chico

\* *Loc. cit.* (1907), ii, p. 43, pl. xi, fig. 3 only.

† *Loc. cit.* (1902), p. 116, pl. ii, figs. 23-25.

formation\* ; but in India it occurs in the Lower Aryalur and Upper Trichinopoly groups, and Haug† has it, both in the Santonian and in the Maestrichtian, on the same page.

The difficulties of exact correlation were probably felt by Kilian and Reboul,‡ who put the beds of Snow Hill and Seymour Islands, that both contain *Kossmaticeras* (*Madrasites*) *bharani*, into the Senonian s.l. (= Santonian to Maestrichtian), placing the lower horizon as equivalent to the Indian Upper Trichinopoly group, whereas the upper beds show close affinity, not only with the Aryalur and Valdayur groups, but also with the Campanian or Maestrichtian deposits of Southern Patagonia. The fact that *Placenticer*, similar to the Zululand forms, occur in the Maestrichtian Fort Pierre Shale of America, perhaps, is in favour of the attribution of the fauna here discussed, and of Pondoland, to this upper horizon of Antarctica ; and it may be added that the two forms here described from the north-west shore of False Bay (*Mortoniceras rannuzemi*, Morton sp., and *Bostrychoceras?* sp) also are of Campanian age ; further, that the isolated specimen of *Peroniceras* cf. *dravidicum*, representing a cast in limonite, after pyrites(?), differs in mode of preservation from the Ammonites of the Umkwelane Hill fauna as from the two forms of *Peroniceras* described by Crick. If not all, at least the great majority of the forms of the Umkwelane Hill and Pondoland Ammonite faunas probably are of Campanian (and Maestrichtian ?) age, and in his phylogenetic interpretation of the genera *Pseudoschloenbachia* and *Diaziceras*, the writer assumed their Upper Senonian age. But the occurrence, at about the limit between the Coniacian and Santonian—at which level the Pondoland fauna had been placed by Grossouvre—and associated with *Mortoniceras texanum*, of forms like *Lenticeras*, *Barroisiceras*§ and what the writer considers to be *Gauthiericeras* developments (*bertraudi-fournieri* group), affords the most striking

\* Kilian and Reboul (*loc. cit.*, p. 60) quote it as Upper Chico, but Anderson (pp. 27 and 98) distinctly characterises it as a Lower Chico species.

† *Loc. cit.*, II, ii, p. 1342.

‡ Table on p. 58, *loc. cit.*, also p. 59. In this Antarctic fauna, also, the great majority of forms are Upper Senonian. The little-known genera *Grahamites* and *Scymourites* show a very striking resemblance to certain Canadian Fort Pierre forms in the British Museum, including *A. barnstoni*, Meek ('Saskatchewan Exploring Expedition: Geolog. Report,' H. Y. Hind, Toronto, 1859, Chapter XIX (by F. B. Meek), p. 197, pl. ii, figs. 1-3).

§ E.g. *B. dentato-carinatum*, Roemer (Hill), a form very near to "*Schloenbachia*" *siskiyouensis*, Anderson (Lasswitz, p. 29, thought them identical), which perhaps resembles the Pondoland form, referred to above, as much as does the Upper Chico "*Schl.*" *chicoensis* (Trask) Anderson.

parallel to the *Mortonicerias-Diuzicerias-Pseudoschloenbachia* assemblage, here recorded from Umkwelane Hill.

It may be added here that whereas, in East Africa, the succession from the Bathonian up to the Aptian\* is represented by generally ammonitiferous deposits, in Zululand, as probably also in Mozambique,† there is a fairly complete succession from the Aptian to the Maestrichtian, with the exception of the Turonian, the presence of which in Madagascar also has not been clearly demonstrated. It is of interest to note that the Coniacian *Peroniceras*, mentioned above, and which is almost indistinguishable from a Bohemian *P. subtriarinatum*, d'Orbigny sp.,‡ is closely comparable with a type that occurs in India and Madagascar and has also been recorded from the Cameroons. Marine connection across Africa certainly did not exist, and the writer thinks the evidence favours Lemoine's§ contention that the communication between the Indian and Mediterranean seas did not, as Kossmat thought, take place *viâ* the south of the African continent. The genus *Peroniceras* also occurs in Tunis and in the Egyptian-Syrian Coniacian, and the Turonian faunas (with *Pagesia* and *Neoptychites*) of Tunis and India are closely allied. Unworked Nigèrian collections with *Pseudotissotia*, *Vascoceras*, etc. (Falconer, Kitson, and Temple Colls., British Museum), show that during the Turonian (as during the Albian) there was connection between the Cameroons Bay and the great sea that covered the whole of the Sahara|| and extended across to India, but no further (Turonian) extensions down the east or west coasts of Africa, can be traced by ammonitiferous deposits, though a different facies may represent the Turonian both in Angola and in Madagascar.¶ *Peroniceras dravidicum*, thus, probably came to the Cameroons by way of Tunis, and not *viâ* South Africa. The distribution of this form, therefore, is not

\* See Zwierzycki, "Ceph. Faun. d. Tendaguru-Sch. i. Deutsch-Ostafrika," *loc. cit.* (1914), pp. 90-91; also Spath, "Jurass. Amm. fr. E. Africa," 'Geol. Mag.,' vol. lvii (1920), pp. 311-20, 351-62.

† The Dipoloceratidae of the Albian are poorly represented there, and "*Mortonicerias* cfr. *candollei*" in Choffat ('Conducia,' 1903, p. 24, pl. vi, figs. 3 and 4) cannot be definitely identified as a form of the Upper Albian *candollei* group.

‡ B.M. No. 88991, Coll. Dr. Fritsch.

§ 'Ét. Géol. Nord de Madagascar,' Paris, 1906, p. 397.

|| A collection of Turonian Ammonites from Sinai (T. Barron Coll.), described in an unpublished paper by Crick, contains *Hoplitoïdes?* and *Vascoceras*.

¶ According to Kilian and Reboul (*loc. cit.*, 1909, p. 64), this Turonian Mediterranean, extending from Brazil to India, did not communicate directly with Madagascar.



of great significance, and, at any rate, there is no record from the West Coast of Africa, of an ammonite indicative of the great Campanian transgression which left the deposits of the Indo-Pacific type (with *Kossmaticeras* and *Lytoceratidae*), and of the Atlantic type (with *Mortoniceras* and *Placenticeras*) discussed by Kilian and Reboul.\*

Of the twenty-nine species of Cephalopoda of the Umkwelane Hill fauna, only one Ammonite (*Pseudoschloenbachia umbulazi*) is identical with a Pondoland species, in addition to a number of uncoiled and straight forms (*Bostrychoceras*?, *Diplomoceras*?, *Baculites*), and to a *Nautilus*. The assemblage of these genera suggests close affinity of this South African fauna with that of the Egyptian Maestrichtian †; but the place of *Pseudoschloenbachia umbulazi*, there, is taken by a new species (doubtfully classed as a Cenomanian *Schloenbachia* by Blanckenhorn [in Coll.]), whereas the plentiful *Eutrephoceras desertorum*, Zittel sp., replaces the form here described as *E. aff. dekayi*, Morton sp. The abundance of *Baculites* and the frequent occurrence of uncoiled forms, in the Egyptian as well as the South African deposits, are further points of similarity; and it may be noted here that *Mortoniceras* of the *delawareuse* group are common to Tunis and Zululand, and that *Parapachydiscus colligatus*, also, has been recorded from Tunis as well as from Madagascar.

The two genera *Mortoniceras* and *Parapachydiscus*, of course, are other elements common to the two faunas, even if the species are different, and it may be recalled here that Newton‡ found "very few of the shells [from Manuan Creek] to occur in contiguous areas, such as . . . Umkwelane Hill and . . . Pondoland. . . ." The great abundance of large forms of *Mortoniceras*, with the equally frequent occurrence of *Hauericeras gardeni*, and the presence of the (less common) *Pseudoschloenbachia*, form the characteristic feature of the Pondoland deposits, and distinguish them from the Egyptian and Madagascar faunas. In the "new collection of Natal fossils, at the Natural History Museum, far surpassing all collections hitherto made" (Kossmat§), out of a total of 105 specimens, 43 are *Mortoniceras*. But it is significant that *Hauericeras gardeni*, a typical Indo-

\* *Loc. cit.* (1909), pp. 64-5. Through the kindness of Mr. Beeby Thompson, of Northampton, the writer has lately (February, 1921), been able to study a new collection from Angola, including Upper Senonian Ammonoids (*Didymocephalus*).

† In Haug (*loc. cit.*, p. 1335), who considers the presence of the Campanian to be doubtful, so that the great Upper Senonian transgression may here have been of a slightly later date.

‡ *Loc. cit.* (1909), p. 95.

§ 'Rec. Geol. Surv. India,' vol. xxviii (1895), pt. ii, p. 43. See also Newton, *loc. cit.* (1909), p. 14.

Pacific element, of which the latter collection includes no fewer than thirty-seven specimens, is unrepresented at Umkwelane Hill, as are the genera *Gaudryceras*, *Tetragonites* and *Pseudophyllites*, the last represented in the new collection by three specimens, one of which reaches the diameter of 290 mm.

The gigantic *Parapuzosia* and the *Placenticerus*, also, are represented only in the Umkwelane Hill fauna, and though occurring in Madagascar, are not known from Pondoland. The Zululand locality also has the unique *Diazicerus* as a strictly local type, whereas in Pondoland *Eulophoceras* and its close ally *Spheniscoceras* form special developments, not occurring elsewhere.

It is clear that this indicates a difference of facies, the stenothermal *Lytoceratidae* being dependent on deeper water or warm currents. Lithologically the difference is indicated by the absence of glauconite in Zululand; and what changes of facies may be observed in a distance equal to that separating the Pondoland Umzamba beds from Umkwelane Hill, is seen when comparing the deposits of the warm coralline Gosau Sea with the contemporaneous beds left by the colder Chalk Sea. These *Lytoceratidae* are absent also in Egypt and Baluchistan, but occur in Madagascar and Southern India, and, as regards Pondoland, their distribution cannot be said to support the view put forward by Grossouvre (and not accepted by Woods), that there was at least as close a relationship to the fauna of the Chalk of Europe as to that of Southern India. The fact that *Mortoniceras*, which forms one of the most important elements of the South African faunas, is absent in India, of course constitutes a striking difference, and might unduly encourage comparison with corresponding European assemblages such as those of Galicia or Poland, where *Hauericeras gordeni* and *Kossmaticeras* (?), two Indo-Pacific elements, occur. Taking the South African fauna as a whole, however, its affinity with the Indo-Pacific fauna is undeniable, and, as has been mentioned before, the "Atlantic" type of deposit (with *Mortoniceras* and *Placenticerus*) found in Zululand, and the Indo-Pacific type (with *Lytoceratidae* and *Kossmaticeras*) occurring in Pondoland,\* are connected by the presence in both faunas of *Pseudoschloenbachia*, probably an active swimmer, and of benthonic crawlers (*Diplomoceras*, *Bostryhoceras*) and mud-boring *Baculites*.

Of particular interest, perhaps, are the two turricones of the

\* It is interesting to note that the additional Ammonites from Pondoland, lately described by Dr. van Hoepen, and, with one or two exceptions, the fauna sent by the Durban Museum, consist of such "Indo-Pacific" types, unknown at Umkwelane Hill.

Umkwelane Hill fauna, partly because they represent benthonic types of limited powers of migration, compared with the oxycone developments of the Upper Senonian, that might be thought to have been active swimmers, but are often curiously restricted, just as other marine organisms often may have a limited horizontal distribution.\* Their nearest allies, hitherto described, are European, Japanese and North American forms, but in an unworked Egyptian Collection in the British Museum there are, besides *Bostryhoceras*, which also occurs in Tunis, Baluchistan, India and Madagascar, fragmentary Nostoceratids, comparable with the Zululand species and with Fort Pierre types from the United States and from Canada.† These forms again point to a direct connection with North Africa, as did *Mortonicer*as, and it appears probable that ever since the breaking up of Suess's Gondwanaland, or at least from the time of the Aptian transgression, the Zululand Cretaceous Sea was open not only to Antarctic-Pacific elements coming from south-west, but was in direct communication, through the Mozambique Channel, with the sea to the north‡ that led to the Mediterranean on the one hand and to India on the other.

Boule, Lemoine and Thévenin§ stated that there was a gradually diminishing number of forms common to the North African and the Madagascar faunas, as the beds became higher in the Cretaceous succession; and they noted the absence of *Tissotia*, which constitutes an important element in the North African fauna. Such a relation, perhaps, is also to be observed in Zululand; but the figures, at any rate, prove little, considering the differences in the facies of two neighbouring areas such as, e. g., Pondoland and Zululand. In the much more completely known Tunisian fauna, both the "Atlantic" and the "Indo-Pacific" types (though the latter without *Kosmaticer*as) are represented. If, however, the Umkwelane Hill fauna be compared with the neritic Egyptian or European faunas and the Pondoland fauna with a corresponding bathyal|| assemblage of North

\* Mr. S. S. Buckman ("Jurassic Chronology: I, Lias," Suppl. I, 'Q. J. G. S., vol. lxxvi, pt. i, 1920, pp. 66-67) considers that analogy with modern organisms does not hold, but his remarks are unconvincing, as a study of the distribution, and dependence on facies, of the two fundamental stocks of Ammonites (*Lytoceratidæ* and *Phylloceratidæ*) will show.

*Exilloceras* cf. *angulatum* (Meek), *Didymoceras*?, sp. (cf. *Heteroceras polyploum*, Römer sp. (pars), in Schlüter, 1872, p. 112, pl. xxxiv, fig. 1 only). Comparable forms have also been discovered in Angola (see footnote on p. 269).

‡ In Krenkel's sense ("Unt. Kr. v. D.-Ostafri.," 'Beitr. Pal. Öst.-Ung.,' vol. xxiii, 1910, p. 249).

§ *Loc. cit.* (1907), p. 71.

|| The term "bathyal" is misleading, for *Lytoceratidæ*, e. g., may occasionally occur in comparatively shallow-water deposits (*jureuse*-zone).

Africa or Europe, the agreement may be found to be less close than it was during Albian times.

Uhlig\* thought that the aspect of the [Jurassic and Lower Cretaceous] fauna as a whole justified the establishment of an Ethiopian province by Neumayr, later regarded by Dacqué and Krenkel as a sub-area of the Indian Province. In the Upper Cretaceous, this "Ethiopian Province" had lost its individuality, if it ever formed a separate province; for, *e.g.*, Haug points to the presence of the peculiar genus *Bouleiceras* in Madagascar as possibly indicating a separate zoological province, but the writer has found a specimen of *B. nitescens*, Thévenin, in a Domerian-Toarcian collection from Baluchistan.† At any rate, in the Upper Cretaceous, the Indo-Malagascan fauna shows the closest relations with those of the Pacific and Antarctic provinces; and the most characteristic element of this vast "Indo-Pacific" province is the genus *Kossmaticeras*, as pointed out by Haug.‡ Through a slip, this author also stated§ that *Kossmaticeras* was not known either in Madagascar or in South Africa, whereas on pp. 1344 and 1355 he quotes it from both localities.

Under the description of *Kossmaticeras (Madrasites) bhavani*, Stoliczka sp., in the Manuan Creek fauna, the writer has referred to various South African forms, and other hitherto unrecorded species of *Kossmaticeras* and allied genera from New Zealand, and the presence of this genus in South Africa shows the fauna to belong to this great "Indo-Pacific Province"|| in spite of the number of "Atlantic" types introduced from the North *viâ* Egypt.

\* "Marine Reiche d. Jura and d. Unterkr.," "Mitt. Geol. Ges. Wien," iv (1911), 3, p. 406.

† British Museum (Geol. Society Coll.), from Valley of Kelat, Baluchistan, together with *Phylloceras*, *Rhacophyllites*, *Lytoceras*, *Fucinicer*, *Protogrammocer*, *Dactylioceras*, etc.

‡ *Loc. cit.*, vol. ii, 2, p. 1369.

§ *Ibid.*, p. 1369.

|| The communication, to the West, with Graham Land, Southern Patagonia and Chili, is perhaps even more certain, and in all these areas, as pointed out below (p. 307), the deposits consist largely of glauconitic, calcareous sandstones, contain the same fossil assemblages, and apparently pass uninterruptedly into the lower Eocene.

## III. THE MANUAN CREEK FAUNA.

## DESCRIPTION OF SPECIES.

## A. ALBIAN.

## 1. AMMONOIDEA.

## FAMILY: PHYLLOCERATIDÆ.

## GEN. PHYLLOCERAS, Suess.

## 1. PHYLLOCERAS VELLEDAE, Michelin sp.

1906. Boule, Lemoine & Thévenin: "Pal. de Madagascar, III, Céph. d. Diego-Suarez," Ann. de Pal., vol. i, fasc. 4, p. 7, pl. i, fig. 11.
1907. Crick. Third Report, p. 236 (*Phylloceras* sp.), B.M., No. C18264.

This well-known form is represented by a fragment (No. 4992) completely septate, of a large example, agreeing both with the Zululand and Madagascar specimens and with d'Orbigny's\* and Pietet's† European types, in whorl-shape, ornamentation and suture-line. At a diameter of 130 mm. the thickness is 47 mm., or 36 per cent. of the diameter, which agrees with that of d'Orbigny's type. The fragment, being nearly half of the Ammonite, shows the inner whorls in section, and at a diameter of 54 mm. the thickness still is 36 per cent., whereas the example figured by Crick as *P. velledae*, Stoliczka (*non* Michelin?), has very flat sides, considerably more compressed than Stoliczka's large example.‡ Crick's figured specimen, which also shows striation only on the periphery, though the sides are weathered, probably also is of later (*i. e.* Cenomanian) age, and may be closer to the variety figured by Boule, Lemoine and Thévenin in fig. 10.¶ On the other hand, the *Phylloceras* sp., from the South Branch of the Manuan Creek, recorded by Crick, is identical with the form here described.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

\* *Loc. cit.* (1840), p. 280, pl. lxxxii.

† In Pietet and Roux, *loc. cit.* (1847), p. 30, pl. ii, fig. 1.

‡ *Loc. cit.* (Third Report, 1907), p. 166, pl. x, fig. 11 (B.M., No. C18137).

§ *Loc. cit.* (1865), p. 116, pl. lix, fig. 2.

¶ Of pl. i. This is dated, in explanation of plate, as "Cénomanien supérieur," but in the text (p. 8) the horizon is given as "Sénonien inférieur."

## FAMILY: DESMOCERATIDÆ.

## GEN. PUZOSIA, Bayle.

## 2. PUZOSIA cf. BHIMA, Stoliczka sp.

Compare:

1865. *Amm. bhima*, Stoliczka. Cret. S. Ind. vol. i, p. 137, pl. lxi, fig. 2.  
 1898. *Puzosia bhima*, Kossmat. Unters. S. Ind. Kreidef. pt. iii, Beitr. Pal. und Geol. Öst.-Ung., etc., vol. xi, p. 119.  
 1907. *Puzosia pinguis*, Crick. Third Report. Geol. Surv. Nat. and Zulul., p. 218.

A fragmentary example (No. 4907), originally of about 200 mm. diameter, but still septate at the end, shows close agreement with Stoliczka's large specimen and with the very similar False Bay form. The dimensions probably were:

Height of the last whorl	. 46	per cent. of the diameter
Thickness	„ „	. 39 „ „ „
Umbilicus	. . .	. 25 „ „ „

On the test, which is 1.5 mm. in thickness, the varices are not shown, but there is a labial ridge across the periphery, corresponding with a sulcus on the cast, though this sulcus extends across the sides as well. In addition to these ridges, which form a less acute sinus on the venter than they do in *P. bhima* or *P. pinguis*, there is faint and irregular striation on the test. The presumably Cenomanian *P. subtilis*, Crick,\* has very similar ornament, but is more compressed (thickness = 31 per cent.) and more involute (umbilicus = 20 per cent.). *P. pinguis*, Crick, with a thickness of 36 per cent., appears to be merely an inflated form of the *subtilis* type; but since it may be of Cenomanian age, and since the suture-line cannot be compared, its exact relations to *P. bhima* must remain somewhat uncertain. The larger fragment in the British Museum (No. C18243) is extremely close to the specimen here described, and differs, apart from slightly varying proportions, only in having more acutely linguiform ridges on the periphery—a character in which it is nearer to the Indian species than to the specimen here described.

*P. insculpta*, Kossmat† is more compressed, but the large examples

\* *Loc. cit.* (Third Report), p. 217, pl. xiv, figs. 5, 5 a.

† *Loc. cit.* (1898), p. 120, pl. xviii, fig. 5.



from Madagascar figured by Boule, Lemoine and Thévenin\* are very close to the present specimen. On the other hand, the writer would doubt whether Sharpe's *P. octosulcata*,† included by Pervinquière ‡ in *P. mayoriana*, d'Orbigny sp., is as close to *P. bhima* as Kossmat thought. *P. compacta*, Crick,§ from the Middle Tributary of the Manuan Creek, and probably of the same age as the form here described, *i. e.* Upper Albian, may be the young of a form of the *planulata* group, comparable with *P. octosulcata*. *P. concinna*, Crick,|| from the same locality, was stated to come nearest *P. bhima*, but has only five constrictions, distinct costation at a small size, and a far less conspicuous forward sweep of the sulci, so that this species also has closer relations with the *planulata* group than with the *insculpta-bhima* group.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

#### GEN. UHLIGELLA, Jacob.

##### 3. UHLIGELLA? sp. nov. aff. STOLICZKAI, Kossmat sp.

Compare :

1865. *Amm. beudanti*, Stoliczka. Cret. S. Ind., vol. i, p. 142, pl. lxxi, figs. 2-4, non fig. 1.  
 1898. *Puzosia stoliczkai*, Kossmat. "Untersuch. S. Ind. Kreidef.," pt. iii, Beitr. Pal. und Geol. Öst.-Ung., xi, 3, p. 119, pl. xviii, fig. 6.  
 1907. *Puzosia stoliczkai*; Crick. Third Report Geol. Surv. Nat. and Zulul., p. 216.  
 1908. *Puzosia (?) stoliczkai*; Jacob. "Et. Pal. and Strat. Part. Moy. Ter. Crét.," Trav. Lab. Géol. Univ. Grenoble, vol. viii, p. 350.

The specimen (No. 4902) that is referred to this species is somewhat fragmentary, but permits of the dimensions being measured at the following two diameters :

Diameter	. . . . .	120 mm.	54 mm.
Height of last whorl	. . . . .	46 per cent.	41 per cent.
Thickness	„ „ . . . . .	30 „	30 „
Umbilicus	. . . . .	24 „	30 „

\* *Loc. cit.*, I (1906), p. 19, pl. iii, figs. 2-4. These authors state that *P. stoliczkai* has a notably wider umbilicus than *P. insculpta*, whereas Kossmat's figures are 22 per cent. and 25 per cent. respectively for the umbilical widths in these two species.

† *Loc. cit.* (1856), p. 42, pl. xix, fig. 3.

‡ *Loc. cit.* (1907), p. 157; but see the writer's "Cret. Amm. from Angola, to be published shortly.

§ *Loc. cit.* (1907), p. 246, pl. xv, fig. 7 (B.M., No. C18307).

|| *Loc. cit.* (1907), p. 245.

These figures indicate that with increase in size, the umbilicus becomes narrower, whereas the Indian examples appear to be more involute in the young. The inner whorls of the present example are smooth, as are Stoliczka's specimens; but on the periphery of the outer whorl costation appears, between the numerous sulci, as in *P. compressa*, Kossmat.\* A further point of difference is the slight flattening of the sides in the Zululand example, combined with a wider venter, making the whorl-section more rectangular than that of Stoliczka's larger example (fig. 3 a), *i. e.* more like that of his fig. 2 a. The umbilical slope, also, is inclined, not perpendicular, or even overhanging, as in Stoliczka's species, and agrees with that of Crick's specimen.

The constrictions, however, are very similar to those of Kossmat's species, and it may be recalled that Crick already had described his example as being slightly more compressed than Stoliczka's fig. 3 a. The False Bay example also has, at a diameter of 82 mm., practically the same dimensions as the larger specimen here described.†

Etheridge‡ figured a very large "*Desmoceras* sp." from the Albian of the Umsinene River, in the neighbourhood of the Manuan Creek, and thought it possibly allied to the "Ootatur form of *D. beudanti* (Brongniart)" = *P. stoliczkaei*, Kossmat, 1898. The presence of costation might suggest that it is a large example of the form here described, in which ribbing appears near the end; but the constrictions appear to be quite different, and it is probable that Etheridge's form is related to the forms of the *planulata*-group, with straight constrictions, found in Angola.

*Puzosia* of the *insculpta-bhima* group, referred to above, have a different course of the constrictions, and the costate *planulata* group is too evolute. The reference of the present form to *Uhligella*, after Jacob, the author of the genus, appears somewhat doubtful.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

\* = *A. durga*, Stoliczka, *non* Forbes, *loc. cit.*, pl. lxxi, fig. 7.

† A specimen, not noticed by Crick in his paper, but labelled by him ? *Beudanticeras beudanti*, Brongniart sp. (B.M., No. C18303), is identical with the form here described, and *Hauericeras* sp. (recorded on p. 243), together with a second *Hauericeras* ? sp., not mentioned in the paper (B.M., Nos. C18276-77), probably also belong here.

‡ "Cret. Foss. Natal," II, 'Third Report Geol. Surv. Nat. and Zulul.,' 1907, p. 88, pl. vi.

## FAMILY: DIPOLOCERATIDÆ.

## GEN. DIPOLOCERAS, Hyatt.

## 4. DIPOLOCERAS CRISTATUM, Deluc sp.

(Pl. XXV, fig. 2; Pl. XXVI, fig. 6.)

1822. *Ann. cristatus*, Deluc in Brongniart. Environs de Paris, pp. 95 and 395, pl. vii, fig. 9.1907. *Mortonicerus (?) cristatum* (Deluc), Pervinquière. Et. d. Pal. Tunis. Céph. Ter. Second, p. 239.1908. *Mortonicerus (?) cristatum* (Deluc), Jacob. "Et. Pal. and Strat. Part. Moy. Ter. Crét.," Trav. Lab. Géol. Univ. Grenoble, vol. viii, pp. 326 and 384.

This well-known species is represented in the collection by two examples of the following dimensions:

	No. 2728.	No. 2727.
Diameter . . . . .	144 mm.	65 mm.
Height of last whorl . . . . .	35 per cent.	33 per cent.
Thickness ,, ,, (at promi- nent costae) . . . . .	? 40 ,,	44 ,,
Umbilicus . . . . .	39 ,,	40 ,,

There is particularly good agreement with the coarse form figured by Brongniart. The keel is narrowed at its base, like that of the form described below as *D. sp. nov.* or of Ooster's *A. roissyanus* (d'Orbigny) *varietas*.\* The extremely pronounced forward sweep of the costation, near the end of the large example (see fig. 2, Pl. XXV), is particularly striking. This probably represents the mouth border with its rostrum, but unfortunately the latter is not perfectly preserved.† The length of the body-chamber is well over half a whorl; the last few (approximate) suture-lines are very simple but could not be exposed sufficiently well for complete delineation. What can be seen differs from the suture-line figured by Pictet‡ (fig. 5 c) in having shorter and wider elements and from that of fig. 2 c in having simpler outlines. The internal portion shows part of the dorsal saddle, but the antisiphonal lobe is hidden by matrix that did not permit of further preparation.

\* 'Catal. Céph. Foss., etc.,' 1860, iv, p. 144, pl. xxvi, figs. 6 and 7.

† d'Orbigny's figure (*loc. cit.*, pl. lxxxviii, fig. 1) probably is restored and composite, for according to the evidence of the example here described, the curve of the costae near the end is quite different, and all tuberculation has disappeared.

‡ In Pictet &amp; Roux, 'Moll. Foss. Grès. Verts.,' 1847, pl. viii.

The smaller example is distinguished from equal-sized European specimens of the *subcristatus* type, as figured by d'Orbigny and Sowerby (in Fitton), in having straighter and more rigid costation. This is reminiscent of *D. cornutum*, and some fine specimens of the latter species, much larger than Pictet's type, from the Astier Collection in the British Museum (*e.g.* Nos. 37610 [88]) show comparable ornamentation near the end, after decline of the tuberculation has set in. Only the thickness is far greater in Pictet's species than in *D. cristatum*, and the prominences on the inner whorls are blunter.

The *Schloenbachia* sp., recorded by Crick\* from the Middle Tributary of the Mannan Creek, and compared with d'Orbigny's *A. delaruei* and Pictet's *A. cornutus*, is a badly preserved and immature example of a *Dipoloceras*; but a larger fragment (No. C18301) of a similar form, close to both the large *D. cornutum* from Escragnolles, mentioned above, and to the typical *D. cristatum* in Brongniart, was worked out of the matrix of one of the Nautili described on p. 244 by Mr. Crick, but was not referred to in the paper.

The large example, in peripheral view of the final, costate portion, somewhat resembles Marcou's *A. shumardi*†; but that species has no "flares," has weak outer and strong inner tubercles, and is transitional from *Dipoloceras* to *Subschloenbachia*.

*Locality*.—Mannan Creek. Coll. Resident Magistrate, Ubombo.

### 5. DIPOLOCERAS QUADRATUM, sp. nov.

(Pl. XXV, figs. 3 a-c.)

Cf. 1847. *A. bouchardianus* (d'Orbigny) Pictet. In Pictet & Roux, Moll. Foss. Grès. Verts., p. 350, pl. viii, fig. 9.

This species is based on a specimen (No. 4955) of the following dimensions:

Diameter	.	.	.	.	43 mm.
Height of last whorl	.	.	.	.	40 per cent. of the diameter.
Thickness	„	„	.	?	45 „ „ „
Umbilicus	.	.	.	.	30 „ „ „

Like the closely comparable specimen figured by Pictet, this

\* *Loc. cit.* (1907), p. 247, B.M., No. C18308.

† 'Geology of N. America' (1858), p. 33, pl. i, fig. 1 (misspelt *shumardi* on plate), holotype in B.M. (Geol. Soc. Coll.) No. 12662. The geological position of this form, in the Upper Duck Creek Formation, below the Fort Worth Beds with *Subschloenbachia leonensis*, seems to correspond with that of the European *Dipoloceras cristatum*.

Ammonite is distinguished from the true *D. bouchardianum*, d'Orbigny,\* by its evolute and square whorls, with a wide, carinati-sulcate ventral area. It may be considered to form a transition towards the *subcristatum* and *subinflatum* groups, as d'Orbigny's compressed type has leanings towards *Pseudophacoceras roissyanum*, d'Orbigny sp. The resemblance of Pictet's example to *D. subcristatum* consists chiefly of the peculiar trifurcation of some of the costae; whereas in the smaller Zululand specimen, comparable with the inner whorls of Pictet's form, this resemblance is due to the slightly greater prominence of one or two of the costae, though there are no conspicuous flares, such as are characteristic of the *cristatum* group.

The present example, on the other hand, does not show the umbilical tuberculation that is so notable a feature in Pictet's much larger specimen, but, as in d'Orbigny's species, a pair of costae may be thickened where they meet at the umbilicus. The example, perhaps, might be thought to represent only the inner whorls of a large specimen, such as Boule, Lemoine and Thévenin's "*Schloenbachia* cf. *bouchardiana*."† It appears probable, however, that the last half-whorl, at least, of the present example belongs to the body-chamber, though the suture-line, unfortunately, cannot be made out.

The Madagascar specimen, referred to above, which is larger than any European form of this group, and therefore difficult to compare, apparently does not agree either with d'Orbigny's species or with the species here discussed, and may represent a new type. In *D. subinflatum*, Pictet sp.,‡ and in *D. rouxianum*, Pictet sp.,§ the umbilical tuberculation is far too pronounced.

Forms comparable with the present species, but not with d'Orbigny's form, are found in bed VIII at Folkestone, but in the succeeding zones, forms belonging to the group of *Brancooceras symmetricum*, Sowerby sp., are common, and often confused with *D. bouchardianum*.|| Other transitional forms of *Dipoloceras* from the *cristatus* zone of Folkestone differ from the present species in having the point of bifurcation of the costae moved farther away from the umbilicus.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

\* *Loc. cit.* (1840), p. 301, pl. lxxxviii, figs. 6-8.

† *Loc. cit.* (1907, ii), p. 39, pl. ix, fig. 11.

‡ In Pictet and Roux, *loc. cit.* (1847), p. 104, pl. x, fig. 1. A specimen in the British Museum, also from Mt. Saxonet (No. C. 10399) forms a transition to *Brancooceras symmetricum* (Sow.).

§ *Ibid.*, p. 99, pl. ix, figs. 2 a, b.

|| See Price, "On the Gault of Folkestone," 'Q.J.G.S.' vol. xxx (1874), table on p. 362; and Jukes-Browne and Hill, 'Cret. Rocks Britain,' I, "Gault and Up. Gr. Sd. of Engl.," tables on pp. 82 and 459.

## 6. DIPLOCERAS sp. nov.

(Pl. XXVI, figs. 5 a, b.)

Cf. 1910. *Schloenbachia* n. sp. Böse, "Mon. Geol. & Pal. d. Cerro de Muleros," Bol. Inst. Geol. Mexico, No. 25, p. 74, pl. viii, fig. 6.

The fragment (No. 4903) to be described, unfortunately, is too incomplete to justify the creation of a new species, but the characters of the body-chamber, as well as of what is preserved of the inner whorls, clearly distinguish it from the previously described forms of this group. The measurements, based on the restoration of the complete shell, shown in fig. 5 a, are:

Diameter	. . . . .	39 mm.
Height of the last whorl	. . . . .	46 per cent. of the diameter
Thickness „	„ . . . . .	35 „ „ „
Umbilicus „	„ . . . . .	22 „ „ „

Except for the smaller umbilicus of the present example, these measurements agree with those of *D. sergipense*, White sp.\* There is a similar strong outer tubercle and high keel, but the latter, in the Zululand specimen, is of the shape of that of *A. roissyanus* (d'Orbigny) *varietas*, Ooster,† or of many specimens of *Dipoloceras cristatum*, that are well enough preserved—that is to say, it is thinner at its base than at its middle height, and becomes thin and sharp again at the edge. But the present species has a second small tubercle half way between the much more prominent outer tubercle and the umbilical suture. Similar bituberculation is shown in some varieties of *D. (Mojsisovicsia?) delaruei*, d'Orbigny sp., e. g. the form figured by Parona and Bonarelli,‡ only in the present species it is more developed, and altogether the new form, like *Mojsisovicsia ventanillensis*, Gabl sp., shows a decided resemblance to the later *Subschloenbachia*. Of the bituberculate forms included by Böse in "*Schloenbachia* n. sp.," his figs. 6–8, pl. viii, represent a closely comparable form; but the inner tubercle is hardly indicated, whereas in figs. 4 and 5 it is the outer tubercle that is not prominent enough. Besides, both these examples are represented as having an acute periphery instead of a high keel on a flat periphery, such as is characteristic of *D. sergipense* and the *delaruei* group.

\* "Contrib. Pal. Brazil," 'Arch. Mus. Nac. Rio de Janeiro,' vol. vii (1887), p. 221, pl. xxiv, figs. 1 and 2. A specimen intermediate between this species and *D. (Mojsisovicsia?) delaruei* (d'Orbigny) in the British Museum (No. C4255), from Velez, Colombia, with a smaller umbilicus, is still nearer to the present example, and also shows the steep forward edge of the costae very well.

† 'Catal. Céph. Foss.,' etc., 1860, iv, p. 144, pl. xxvi, figs. 6 and 7.

‡ "Foss. Alb. d'Escragnolles," 'Pal. Ital.,' vol. ii (1896), p. 88, pl. xi, fig. 9 only.



*D. colladoni*, Pictet sp.,\* is too compressed and too evolute; and, in the sectional view, the outer tubercle is not prominent enough; but the character of the ribs, with an occasional rib that does not reach to the umbilical border, is very similar. There apparently is no inner tubercle in this small species, but the high umbilical border, shown in Pictet's fig. 1 *b* indicates how the line of minute inner tubercles (of some of the costae) of the specimen here described first arises. On the other hand, in such a form of *Schloenbachia*? as Quenstedt's evolute "*A. varicosus*,"† with the *Dipoloceras* keel still retained, the inner tubercle has become strongly developed, and the ribbing has lost its flexiradiate and peculiar wedge-shaped character.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

GEN. PSEUDOPHACOCERAS, nov.‡

Genotype: *A. roissyanus*, d'Orbigny, 'Pal. Franç. Ter. Crét.,' p. 302, pl. lxxxix.

7. PSEUDOPHACOCERAS MANUANENSE, nov.

(Pl. XXV, figs. 1 *a-d*.)

1907. *Schloenbachia* sp., Crick. "Cret. Foss. Natal (III)," Third Report, Geol. Surv. Nat. and Zulul., p. 240.

This species is represented by two specimens, the larger of which is taken as type. Their dimensions are as follows:

	No. 2725.	No. 2726.
Diameter.	235 mm.	(at) 80 mm.
Height of last whorl	45 per cent.	52 per cent. of the diameter.
Thickness	20 "	22 " " "
Umbilicus	21 "	15 " " "

At a diameter of 170 mm. the umbilicus of the large example is only 16 per cent., and the uncoiling that leads to an excentrumbilicate (scaphitoid) shell is confined to the last half-whorl, belonging to the body-chamber. At a diameter of 80 mm. there are 20–22 primary ribs per whorl; they bifurcate at varying distances from the umbilical border, and one branch bifurcates again higher up, so that generally

\* In Pictet & Roux, *loc. cit.* (1847), p. 89, pl. viii, figs. 1 *a, b*. Pictet & Campiche (*loc. cit.* [1859], p. 175) wrongly united this species with J. de C. Sowerby's *Brancoceus symmetricum*.

† Non Sowerby ('Cephalop.,' 1849, pl. xvii, fig. 2).

‡ Dealt with in the writer's Angola paper, above referred to.

there are three secondaries to each primary rib.\* On the outer whorl the ornament is considerably weakened. The umbilical border is gently rounded and the slope slightly concave, except on the innermost whorls. The keel is very prominent and narrowed at its base, as in the form of *Pseudophacoceras* described by Ooster and in many *Dipoloceras* (see *ante*, pp. 277 and 280).

The smaller example, which has portions of the outer whorl preserved (not shown in fig. 1 c of Pl. XXV), has its last suture-line at a diameter of about 115 mm., when, here also, excentrumbilication sets in. Unfortunately only the umbilical portion of the outer whorl here is preserved. The (last) suture-line of the larger example, taken at a diameter of 160 mm., apparently differs from that of the smaller specimen, the latter (in fig. 1 c) being nearly half a whorl away from the beginning of the body-chamber, at a diameter of 80 mm. But though comparison at the same (relative) size is impossible without breaking up the type, the dissimilarity, in the writer's opinion, is accounted for by the fairly frequently observed simplification of the last few suture-lines, in Ammonites generally, often accompanied by equalisation of the elements. This is a phenomenon of individual growth and cannot be applied to phylogeny; and it seems to the writer that the suture-line of the smaller specimen (fig. 1 c) indicates that descendants of this group would show the *Sphenodiscus* type of suture-line, with adventitious elements.

The suture-line of the present species differs from that of the less compressed *P. multifidum*, Steinmann sp.,† its nearest relative, chiefly in the greater depth of the ventral lobe and the presence of a larger number of auxiliaries (corresponding to its greater involution)—a character that also is not shown in the more evolute form figured by Lasswitz.‡ The suture-line of d'Orbigny's *A. roissyanus*§ has this deep ventral lobe, but differs in the auxiliaries. On the other hand, in a specimen of *P. aff. roissyanum* (from Escragnoles, in the British

\* This type of ornament is somewhat reminiscent of that of *Neoharpoceas* [gen. nov.] cf. *hugardianum* (d'Orbigny) in Pictet (*loc. cit.*, Pictet & Roux, 1847, pl. x, fig. 3), but the suture-lines are very different in the two stocks. (Genotype = *A. hugardianus*, d'Orbigny, 'Pal. Franç. Ter. Crét.' pl. lxxxvi, figs. 1 and 2.)

† "Üb. Tithon and Kreide i. d. Peruan. And.," 'N. Jb. f. Min., etc.,' II, 1881, p. 139, pl. vii, fig. 1 [*Schloenbachia acuto-carinata* (Shum. sp.) Marcou].

‡ "Kreide-Amm. v. Texas," 'Geol. and Pal. Abh.,' N.F., vol. vi, Heft 4, 1904, p. 22, pl. v, fig. 2. Schlagintweit (see below) questions Lasswitz's identifications, but the present examples indicate that in the case of the secondaries it occasionally is impossible to say whether they result from dichotomous branching or are simply intercalated.

§ *Loc. cit.* (1840), p. 302, pl. lxxxix, figs. 1-3.

Museum, No. 50065), transitional to *P. mirapelianum*, d'Orbigny sp. there is only one auxiliary lobe less than in the present specimen, and the suture-line describes a similar curve, but the lateral lobe is slightly deeper than the ventral lobe.

Shumard's original *P. acuto-carinatum*\* is more evolute and much more distantly costate than the present species; but the form figured as "*Sonneratia acuto-carinata*, Typus," by Lasswitz† forms a closer approach to *P. multifidum* and to *P. manuanense* than to Shumard's type or to d'Orbigny's species.‡ The specimen figured by Böse§ as *Schloenbachia* aff. *acuto-carinata* is similarly closely costate, but differs from the Zululand species in the whorl-section, and in the very pronounced forward projection of the peripheral portion of the costae. A specimen of *P. cf. peruvianum*, v. Buch, from Velez, Colombia, in the British Museum,|| shows similar peripheral projection; but the ribs, all of which are single, have the peculiar perpendicular forward edge, reminiscent of such large examples of *P. roissyana*, d'Orbigny sp., as that figured by Parona and Bonarelli.¶ The suture-line of the evolute Mexican example, on the other hand, shows great resemblance to that of the large specimen here figured, except that there are two more auxiliary lobes in the latter.

One of the specimens included by White\*\* in his *A. buarquiannus* seems close to the present species, but the type (White's figs. 3 and 4) has distant and single costae.

The fragments recorded by Crick, since mounted in plaster, probably belong to a large specimen of this form. *Sphenodiscus* sp.,

\* In Marcy, "Explor. Red River Louisiana" (1853), Appendix E, 'Pal.,' p. 209, pl. iii, fig. 1. The thickness of this form appears to be only about 20 per cent. of the diameter.

† *Loc. cit.* (1904), p. 21, pl. xvii (v), fig. 1, = *A. peruvianus*, Marcou, V, 1 a, b only, non v. Buch (B.M., No. 12718, Geol. Soc. Coll.).

‡ Schlagintweit ("D. Fauna d. Vracon und Cenoman in Peru," 'N. Jb. f. Min., etc.,' Beil. Bd. xxxiii (1912), pp. 64 and ff., includes in "*Schloenbachia*" *roissyana*, d'Orbigny sp., not only *P. acuto-carinatum* (already united with d'Orbigny's species by Lasswitz, 1904, and Douvillé, 1906), *P. multifidum*, *P. mirapelianum* (as varieties), further *P. buarquiannus* (White), *P. peruvianum* (v. Buch), *P. carbonarium* (Gabb), *P. belknapi* (Marcou) [holotype in B.M., No. 12663, Geol. Soc. Coll.], and other comparable forms, but, probably quite wrongly, also Lea's *A. americanus*, apparently a *Pulchellia*.

§ *Loc. cit.* (1910), p. 65, pl. ii, figs. 1-3.

|| No. C4266, comparable with fig. 6 of pl. i in v. Buch ('Petrif. Recueill. en Amer. p. M. A. Humboldt et M. Ch. Degenhardt,' Berlin, 1839, p. 5), and more closely costate than *A. peruvianus*, Marcou, V, 1, non v. Buch (B.M., No. 12664 Geol. Soc. Coll. and writer's coll.).

¶ *Loc. cit.* (1896), p. 88 (36), pl. ii, fig. 8.

\*\* *Loc. cit.* (1887), p. 222, pl. xxiv, figs. 5 and 6 only.

figured by Boule, Lemoine and Thévenin\* from the "Lower Cenomanian" of Madagascar, may represent an allied form of this genus, distinguished by more numerous auxiliaries.

*Locality*.—Manuan Creek. Coll. Resident Magistrate, Ubombo.

GEN. SUBSCHLOENBACHIA, nov.

Genotype: *A. rostratus*, J. Sowerby, 'Min. Conch.,' pl. clxxiii (Oxford University Museum).

8. SUBSCHLOENBACHIA PREROSTRATA, nov.

(Pl. XXIV, fig. 10.)

A fragmentary example (No. 4970), consisting of portions of two whorls (completely septate) of a specimen of 160–170 mm. diameter, belongs to a type of *Subschloenbachia* that is found in Southern Europe, and to which probably the large example figured by Boule, Lemoine and Thévenin† is related, though the latter acquires single costation, resembling that of *S. stoliczkae*, n. nov.,‡ at an earlier stage.

The whorl-section at first is wider than high,§ but becomes quadrate at a later stage. *S. picteti*, n. nov.,|| has a less depressed whorl-section, and shows less coarse ornamentation; on the other hand, *S. orbigny*, n. nov.,¶ or at least the French examples that the writer would consider typical of d'Orbigny's form, agree in the more robust ornamentation, but are compressed. On the shell there is very distinct spiral striation, but the east is almost smooth. The suture-line has deeper lateral lobes than that figured by d'Orbigny. A peculiar feature is a distinct groove on the umbilical slope (Pl. XXIV, fig. 10, marked by arrows) of the east, near the end.

*S. stoliczkae*, nov., which has a depressed whorl-section,\*\* shows the ornamentation of *S. aequatorialis*, Kossmat sp., on its inner whorls; and its near ally, *S. pachys*, Seeley sp., is too closely costate and less tuberculate. The depressed examples of the quadrituberculate *perinflata* group (n. nov. = *A. inflatus*, pars, Pictet & Campiche, pl. xxii, fig. 3 only), and others described in the Angola paper already referred to, are distinguished by their double row of outer tubercles.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

\* *Loc. cit.* (II, 1907), p. 50, pl. xi, fig. 5.

† *Loc. cit.* (II, 1907), p. 40, pl. ix, fig. 7.

‡ = *A. inflatus* (Sow.) Stoliczka, *loc. cit.*, pls. xxvii and xxix, fig. 2.

§ In fig. 10 of Pl. XXIV, the height of the smaller whorl should have been only 27 mm.

|| = *A. inflatus*, Pictet, in Pictet & Roux, 1847, pl. ix, fig. 6, e.g. B.M., No. C3822 (holotype of species) and No. 62116.

¶ = *A. inflatus*, d'Orbigny, 1840, pl. xc, e.g. B.M., No. C901 (holotype of species; thinner, more distantly, coarsely [and recte-] costate, than *S. picteti*).

\*\* Stoliczka, *loc. cit.*, pl. xxix, fig. 2.

## 9. SUBSCHLOENBACHIA cf. TRINODOSA, Böse sp.

(Pl. XXV, fig. 4.)

1910. *Schloenbachia trinodosa*, Böse. "Mon. Geol. & Pal. Cerro de Muleros," Bol. Inst. Geol. Mexico, No. 25, p. 78, pl. x, figs. 2-4.

A whorl-fragment (No. 4972), about 100 mm. long, is comparable with the smaller specimen figured by Böse, but has a slightly more depressed whorl-section. The spiral ornamentation, also, is very well preserved on this (body-chamber?) fragment, whereas the Mexican original, a septate cast, does not show it. The present example is distinguished from the form above described (*S. prerostrata*) by its whorl-section, which difference results in very dissimilar ventral aspects of the two species. The trituberculation also is a distinctive feature of the form here described, quite different from the ornamentation of the earlier group, with the high umbilical tubercle almost at the middle of the side.

Forms similar to this species occur in the Cambridge Greensand and in the Red Chalk, and there exist (at Blackdown) transitions to *S. aequatorialis*, Kossmat sp., on the one hand, and to the bituberculate species, referred to below, on the other.

*Locality*.—South side of Manuan Creek Valley. Coll. W. J. Wybergh.

## 10. SUBSCHLOENBACHIA BISPINOSA, NOV.

(Pl. XXIV, fig. 9.)

This species is based on a somewhat fragmentary specimen (No. 4993) that is weathered on one side, so as to expose, in a natural section, the distant septa of the inner whorls and the more approximate septa of the last quarter of a whorl, which shows the beginning of the body-chamber. The dimensions are as follows:

Diameter	. . . . .	148 mm.
Height of the last whorl	. . . . .	32 per cent. of the diameter.
Thickness	" " . . . . .	30 " " "
Umbilicus	. . . . .	44 " " "

The peculiar whorl-section (Pl. XXIV, fig. 9), with its depressed outer tubercle, shows the distinctive features of this form. The inner whorls agree in ornamentation with those of the Bellegarde variety of *S. prerostrata* (B.M., No. C10547, less depressed than fig. 10, Pl. XXIV), and show spiral striation; the outer whorl, with only a peripheral and an umbilical tubercle (on the ribs that reach to the umbilicus) is

comparable with that of one of Etheridge's Queensland specimens\* and of a common Blackdown form (e. g. B.M., No. 52043). This latter is interesting, since it is connected by quite a series of transitions with *S. orbigny* on the one hand, and with compressed forms converging towards *Prohysterocelest goodhalli* on the other. The Blackdown form stands in the same relationship to *S. bispinosa* as *S. orbigny* to *S. picteti*—that is to say, the Zululand species here described, like *S. picteti*, represents the less coarsely ornamented type. Near the end of the shell the costae become single and equally bituberculate, and on the cast show no trace of spiral striation. The Angola *S. cycloceatoides*, Spath, has similar lateral ornament, but is compressed and has no distinct keel, but merely an angular periphery, like certain *Acanthopleuroceras*.

*S. leoensis*, Conrad sp., ‡ includes a group of bispinose forms that have a certain resemblance to the specimen here described. Whether, however, such forms as, e. g., Hill's *S. leoensis*, § are identical with Conrad's type seems doubtful. Lasswitz || probably has misinterpreted the species altogether, putting it in the Senonian.

A worn fragment (No. 4971) of the body-chamber of a large specimen, in which the costation has become single, in whorl-section and peripheral aspect agrees with the species here described. In somewhat similar body-chamber fragments of *S. stoliczkai* from Angola, the peripheral tubercle is more prominent, elongated longitudinally and projected upwards.

Locality.—Middle Branch, Mannan Creek. Coll. W. J. Wybergh.

## FAMILY: LYELLICERATIDÆ.

### GEN. STOLICZKAIA, Neumayr.

#### II. STOLICZKAIA sp. ind.

1888. *Stoliczkaia dispar* (d'Orbigny) Choffat. In Choffat & de Loriol, "Matériaux . . . Angola," Mém. Soc. Phys. and d'Hist. Natur. Genève, t. xxx, No. 2, p. 69, pl. ii, fig. 6 ?.

1894. *St. clavigera* (Neumayr) Kossmat. "D. Bedeut. d. Südind. Kr. F.," Jb. K.K.R.A., vol. xlv, p. 465.

\* "Low. Cret. Foss., etc.," II, Ceph. ii, 'Records Austral. Mus.,' vii, 4 (1909), pl. lxvi, fig. 1 only.

† Gen. nov. Genotype = *P. wordiei*, nov., a new Angola species of the *candollinum-goodhalli* group.

‡ "Descr. of Cret. and Tert. Foss.," 'Geol. Rep. Mexican Boundary' (1857?), p. 160, pl. xvi, figs. 2 a, b.

§ *Loc. cit.*, 1901, pl. xxxvi, figs. 1, 1 a (as *A. (Schloenbachia) leoensis*, Römer).

|| *Loc. cit.*, p. 23.



A whorl-fragment (No. 4939) of a specimen of about 35 mm. diameter, with the umbilical portion imperfectly preserved, appears to belong to a flexicostate form of this genus, like some of the varieties of *S. dispar*, d'Orbigny sp., figured by Choffat and by Pietet & Campiche.\* The square whorl-section agrees with that of *S. clavigera*, Neumayr,† but in this species, as in the still more quadrate-whorled *S. tetragona*, Neumayr,‡ the costation is too straight. There are nine ribs on the fragment, very thick on the periphery, and of varying lengths.

The specimen of *S. clavigera* from Madagascar, figured by Boule, Lemoine and Thévenin,§ has the inner whorls too poorly preserved for comparison with the much smaller fragment here described.

It should be mentioned that there is no indication of tuberculation on the periphery, such as is shown in Choffat's figs. 5 and 7, in Pietet and Campiche's fig. 1*b*, and in Stoliczka's fig. 3—a feature that becomes permanent in the later *Mantelliceras*, e. g. *M. hoplitoides*, Lasswitz,|| and *M. martimpreyi* (Coquand), Pervinquier.¶ *Mantelliceras* is known to occur in Zululand,\*\* but the presence of a *Stoliczkaia* in the Manuan Creek Fauna is of interest in view of the occurrence of this genus in India and Madagascar, on the one hand, and in Angola and North Africa on the other.

*Locality*.—South side of Manuan Creek Valley. Coll. W. J. Wybergh.

\* *Loc. cit.* (1860), pl. xxxviii. *S. dispar*, d'Orbigny sp., and *S. notha*, Seeley sp., are too compressed and too rounded ventrally.

† In Stoliczka, *loc. cit.* (1865), pl. xlv, fig. 1 (refigured in Lasswitz, 'Kreide A. v. Texas,' *loc. cit.*, pl. iv, fig. 2), and fig. 3 (refigured Kossmat, *loc. cit.*, pl. xxiv [x], fig. 2). Kossmat included the Angola specimens in *S. clavigera* Neumayr, but they belong to several distinct varieties.

‡ In Stoliczka, *loc. cit.*, pl. xlv, fig. 2.

§ *Loc. cit.* (1907), pl. ix, fig. 1, p. 33 (apparently reduced by half, though stated to be natural size).

|| *Loc. cit.* (1904), p. 19, pl. iii (xv), fig. 3. The suture-line of this form (text-fig. 4, p. 19) is little advanced from that of *Lyelliceratidæ*, so that *Mantelliceras* is not a direct descendant of *Stoliczkaia*, but more or less a parallel development with *Neophylliceras*, nov. (genotype = *A. brottianus*, d'Orbigny, 'Pal. Franç. Ter. Crét.,' pl. lxxxv, figs. 8-10), and *Stoliczkaia*, of *Lyelliceratidæ*. (See, however, Nowak, "Unters. Cephal. Ob. Kreide Pol.," II. Skaphiten, 'Bull. Acad. Sci. Cracovie,' July, 1911, p. 554, text-figs. 1 and 2.)

¶ *Loc. cit.* (1907), pp. 289 and 389.

\*\* E. g. *M. choffati*, Kossmat sp.

## FAMILY: HAMITIDÆ.

## GEN. TORNEUTCERAS, Hyatt.

## 12. TORNEUTCERAS sp. ind.

1861. *Hamites virgulatus*, Pictet & Campiche (*non* d'Orbigny). "Foss. Ter. Crét. de Ste. Croix," Mat. Pal. Suisse, III, pt. 2, p. 85, pl. liv, figs. 7 a—d only.

A fragment (No. 4967), about 20 mm. in length, and slightly curved, has seven thick and round ribs that are very prominent on the ventral side but disappear on the dorsum, so that the concave side of the shell appears quite smooth. This agrees with the ornamentation common to several species of "*Hamites*"; but the circular cross-section and very slight obliquity of the ribs suggest comparison with the above form. The example, however, is only preserved as a very poor cast in a brownish, friable, sandy matrix, so that its identification must remain doubtful.

Specimens of *T. virgulatum* from Angola (B.M. No. C20130-1) show very similar ornament, but a more compressed section, like the types of Brongniart and d'Orbigny, and Pictet & Campiche's fig. 6.

Some of the examples figured by Pictet & Campiche on pl. li as *Anisoceras alternatum* (Mantell) show some resemblance to the fragment here described (*e. g.* fig. 6), and it should be mentioned that there is a specimen of a comparable form of *Anisoceras* in the British Museum (No. C18300) from the South Branch of the Mannan Creek, preserved in a similar matrix, but not referred to in Crick's paper. The tuberculation of alternate ribs, however, is very distinct in this fragment.

*Locality.*—South side of Mannan Creek Valley. Coll. W. Wybergh.

## FAMILY: ANISOCERATIDÆ.

## GEN. ANISOCERAS, Pictet.

## 13. ANISOCERAS sp. ind.

(Pl. XXVI, fig. 7.)

Cf. 1861. *Helicoceras thurmanni*, Pictet & Campiche. "Foss. Ter. Crét. Ste. Croix," Mat. Pal. Suisse, III, pt. 2, p. 118, pl. lvi, fig. 5.

A small fragment (No. 4982) of a completely septate, free and unsymmetrical whorl resembles the above form in size, coiling and quadrituberculation, but the costae are broader and all equal. The tubercles are less prominent, agreeing in this respect with those of *Anisoceras pseudopunctatum*, Pictet & Campiche,\* and the costae are slightly weakened between the ventral tubercles, but flattened, after the manner of those of *A. perarmatum*, Pictet & Campiche,† between the ventral and lateral tubercles.

"*Helicoceras*" *astierianum*, d'Orbigny in Parona and Bonarelli,‡ shows only slightly closer coiling than the present form, and other comparable forms, e.g. *Turrilites elegans*, Pictet & Campiche, pars, non d'Orbigny,§ have somewhat similar ornamentation. It appears not probable, however, that the example here recorded represents part of the helicoid initial whorls of an *Anisoceras* of the typical group of *A. saussureanum*, Pictet,|| and *A. oldhamianum*, Stoliczka.¶ The suture-line differs from that of the typical *Anisoceras* in the wide external saddle, and from those equally simple ones of certain Hamitids (*Tornutoceras*) in the unsymmetrical first lateral lobe (Pl. XXVI, fig. 7).

*Locality*.—Low Ridge, about three miles east of foot of Lebombo Mountains, north of M'Kusi River, due east of Ubombo. Coll. W. J. Wybergh. This is the only specimen in the present collection from this locality, further north than that of any of the other (post-Aptian) Cephalopoda; but the facies appears to be the same as that of the Albian Mauau Creek fauna.

## FAMILY: TURRILITIDÆ.

### GEN. TURRILITES, Lamarek.

#### 14. TURRILITES cf. GRESSLYI, Pictet & Campiche.

1907. *Turrilites gresslyi*. Boule, Lemoine & Thévenin: "Céph. d. Diego-Suarez," Ann. d. Pal., vol. ii, p. 57, pl. ii, fig. 2.

A small portion of a *Turrilites* (No. 4954), with five rows of tubercles, agrees with the example from Madagascar, in having the upper two tubercles very close together. Since these coincide with the upper

\* *Loc. cit.*, p. 74, pl. lii, figs. 1-3.

† *Ibid.*, pl. xlix, figs. 2, 4a.

‡ *Loc. cit.* (1896), p. 102 (50), pl. v, fig. 13.

§ *Loc. cit.*, e.g. pl. lvi, fig. 10b.

|| In Pictet and Roux (1847), p. 118, pl. xiii (*Hamites*).

¶ *Loc. cit.* (1866), p. 175, pl. lxxxiii, figs. 1-4.

suture and the lowest (indistinct) row of tubercles with the lower suture, only the two median rows are clearly visible at the middle of the sides, as pointed out by Boule, Lemoine and Thévenin. In the Ste. Croix specimens, however, the three rows of lateral tubercles appear to be more equal-sized, and the upper two rows are not so close together.\*

Specimens of *T. cenomaneensis*, Schlüter,† from Wiltshire and Wissant, France, of undoubted Cenomanian age (zone of *Schloebachia varians*), show the closest agreement with the present fragment in the arrangement of the tubercles; but shape and coiling of the whorls are slightly different in the Cenomanian species. The *Turrilites* recorded by Crick‡ from the Cenomanian of False Bay, Zululand, belong to different species.

Locality.—South side of Manuan Creek Valley. Coll. W. J. Wybergh.

## 2. NAUTILOIDEA.

### GEN. CYMATOCERAS, Hyatt.

#### 15. CYMATOCERAS MANUANENSE, G. C. Crick sp.

1907. *Nautilus manuanensis*, G. C. Crick. *Loc. cit.* (Third Report), p. 243, pl. xv, figs. 6, 6 a.

This species was founded for a "less tumid, more finely ornamented and more narrowly umbilicated shell than *Nautilus pseudo-elegans*, d'Orbigny." Crick stated that it was "numerously represented in Mr. Anderson's collection from the Manuan Creek," but it is possible that the specimens do not all belong to the same species, and that some fragments (*e.g.* B.M., No. C18283) belong to such a Senonian *Cymatoceras* as *Nautilus elegans* (Sowerby) in Boule, Lemoine and Thévenin;§ for Albian and Senonian forms occur together at the south branch of the Manuan Creek, and there are slight differences in the matrices. Taking the figured example (B.M., No. C18282) as type of Crick's species, the differences from d'Orbigny's *N. pseudo-*

\* Pietet et Campiche, 'Ter. Crét. de Ste. Croix,' 2nd ser. (1861), p. 132, pl. lviii, figs. 11-13.

† *Loc. cit.* (1876), p. 11 (131), pl. ii (xxxvii), figs. 6 S. (Cf. *Turrilites tuberculatus* (pars) Sharpe, *loc. cit.*, III, 1856, pl. xxv, fig. 3 only.) (Writer's Coll.)

‡ *Loc. cit.* (1907), pp. 173-8.

§ *Loc. cit.* (1907), p. 66, pl. xv, fig. 4.

*elegans*\* seem to be a less broad periphery and less coarse, if equally distant, costation. The proportions of diameter to thickness (3 : 2) are about the same in the two forms, but on account of its broad periphery d'Orbigny's figure appears considerably more tumid than that of *N. manuanensis*, as does the figure of the type-specimen given by Foord.† On the other hand, *C. pseudo-elegans* is of Barremian age, whereas among Albian forms the example figured as *N. albensis*, d'Orbigny, by Pietet & Campiche‡ appears to be almost indistinguishable from Crick's species. The differences are the slightly greater thickness of the European species and the less pronounced peripheral sinus in the costation, possibly also the absence of bifurcation. These may not be characters of specific importance, for sexual dimorphism is proved in the recent *Nautilus*, and among some fifteen presumably Albian *Cymatoceras* from the Manuan Creek there are no two alike.

One example in the collection (No. 4991) of the following dimensions—

Diameter . . . . .	185 mm.
Thickness . . . . .	120 „ (?)

differs from the holotype only in showing fine costation at the end of the shell, which, then, is still septate, whereas on the body-chamber of Crick's figured specimen, in the one place where the test is preserved, the ornament does not show this tendency to become finer and closer.

*C. virgatum*, Spengler sp.§ has coarser ornamentation than *C. manuanense*; and *C. carlottense*, Whiteaves sp.|| differs in its small and shallow umbilicus.

*C. crebricostatum*, Blanford sp.¶ differs from the form here described chiefly in its more sinuous septa, and in a less linguiform peripheral sinus of the costae.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

#### 16. CYMATOCERAS cf. MANUANENSE, G. C. Crick sp.

One example (No. 4990) agrees with Crick's holotype of *N. manuanensis*, but the coarse plication only appears on the shell of the ventral

\* 'Pal. Franç. Ter Crét.' (I), 1840, p. 70, pls. viii and ix, fig. 1. The ratio of diameter to thickness is 3 : 2 according to the text.

† 'Catalogue Foss. Ceph. Brit. Mus.' (II), 1891, p. 253, fig. 59 on p. 255.

‡ *Loc. cit.* (Ste. Croix, I) (1859), p. 134, pl. xvii, figs. 1 a and b only.

§ *Loc. cit.* (1910), p. 130, pl. xi, fig. 3.

|| "Mesozoic Fossils," I, 'Geol. Surv. Canada,' pt. iv, 1900, p. 269, pl. xxi.

¶ 'Pal. Indica,' I, "Foss. Ceph. Cret. Rocks S. India," 1861, p. 36, pl. xxi, fig. 3, and pl. xxii.

area at a late stage, and up to a diameter of about 90 mm. there are only striae of growth. This is reminiscent of the Barremian *N. pseudo-elegans*, d'Orbigny, the genotype of *Cymatoceras*, and the measurements also agree with those given by the author of this species. These dimensions are, in the specimen here described :

Diameter . . . . .	180 mm.
Thickness . . . . .	115 ,, (64 per cent. of the diameter)
Height of the last whorl (in siphonal plane) . . . . .	65 ,,

Another apparently Albian but imperfect specimen of a *Cymatoceras*, in the British Museum, No. C18298, not referred to in Crick's paper, shows a similarly late appearance of costation. This and another example (No. C18299) of the same imperfect set of *Nautili*, not mentioned in Crick's Report, are interesting as showing approximation of the last few septa (see Crick, 'Proc. Geol. Soc.,' No. 979, p. 3, November 11th, 1915).

Foord\* describes, from the Gault, a "species which, on the whole, agrees very closely with Pictet and Campiche's description and figures of *N. albensis*, but differs from it in respect that up to a certain [variable] stage of growth the test is smooth. . . ." The present example thus would seem to stand in a similar relation to *C. manuanense*.

One of the imperfect specimens mentioned by Crick,† on p. 245 (B.M., No. C18295) as "probably referable to *Entrephoceras*" may belong to the same species as the form here described, and at any rate is a *Cymatoceras*. Another of the examples (C18294) is referable to *Cymatoceras kayeanum*, Blanford sp., or a similar compressed species, whereas the remaining two specimens (Nos. C18292 and 93), preserved in limonite, may be of Senonian age.‡

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

#### 17. CYMATOCERAS cf. ALBENSE, d'Orbigny sp.

1859. *Nautilus albensis*, d'Orbigny. In Pictet & Campiche, Pal. Suisse, 2nd ser., p. 134, pl. xvii, figs. I a and b only.

1891. *Nautilus albensis*, Foord. Catal. Foss. Ceph. Brit. Mus., ii, p. 258.

One specimen (No. 4989) differs from the holotype of *C. manuanense*, Crick sp., and from the examples above described in being slightly

\* *Loc. cit.* (1891), p. 259.

† *Loc. cit.* (1907), Third Report, pt. ii.

‡ See under *Cymatoceras*? sp. cf. *justum*, Blanford sp., p. 301.



thicker, having a more obtuse sinus on the periphery, and a coarser costation. Its dimensions are:

Diameter . . . 135 mm.

Thickness . . . 100 „ (74 per cent. of the diameter).

The whorl-shape agrees with that of the type-figure in Pictet and Campiche, and is more rounded than that of *N. pseudo-elegans*, d'Orbigny, or those of the three forms of *Cymatoceras* described below.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

#### 18. CYMATOCERAS, sp. ind.

One example of *Cymatoceras* (No. 4987) differs from the above forms of the *manuanense-albense* group in having a flattened periphery, but it agrees with some of the fragmentary co-types of *C. manuanense*, Crick sp. These differences in whorl-shape are not important; and since the present example is somewhat fragmentary, a definite identification is impossible. The last septum is shown at a diameter of about 90 mm., followed by a portion of the body-chamber.

The smooth earlier whorls, in addition to the flattened periphery, separate it from the holotype of *C. manuanense*, and the finer, dichotomous costation also from *C. albense*. The example agrees with *C. pseudo-elegans*, d'Orbigny sp., in ornamentation, dorsocentran position of the siphuncle and flattened periphery, but is not quite so depressed. *C. kossmati*, Spengler sp.,\* has a narrower whorl-section.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

#### 19. CYMATOCERAS, sp. nov? ind.

1907. *Nautilus* sp., Crick, *loc. cit.*, p. 244.

Among five specimens of *Cymatoceras*, referred to by Crick as representing "a large species which, in external characters, differs from *N. manuanensis* chiefly in having flatter sides and a more broadly-rounded periphery," four are comparable with the various forms of the *manuanense* group described above, but are not well enough preserved for definite identification. On the other hand, one example (No. C18291) agrees in its squarish whorl-shape and fine ornamentation with a large specimen in the present collection (No. 2589) that has the following dimensions:

Diameter . . . 190 mm.

Thickness . . . 125 „ (66 per cent. of the diameter).

The ratio of diameter to thickness, about 3:2, corresponds with

\* *Loc. cit.* (1910), p. 129 (= *N. pseudo-elegans*, Blanford, *non* d'Orbigny).

that of *C. pseudo-elegans* and *C. manuanense*, but the costation is much closer in the present example, and in the specimen described by Crick, than it is in either of the two species mentioned, and the flat, sub-parallel sides and broader periphery separate them especially from *C. manuanense*.

*C. virgatum*, Spengler sp.,\* and *C. striaticostatum*, Crick sp.,† have the squarish whorl-shape of the form here described, but their costation is much coarser or more distant than that of any of the Zululand examples of the genus *Cymatoceras* here dealt with.

In closeness of costation this species approaches to the Cenomanian *Cymatoceras elegans*, J. Sowerby sp.,‡ though its whorl-shape is more like that of the older *C. pseudo-elegans*, d'Orbigny sp.

*Locality*.—Manuan Creek. Coll. Resident Magistrate, Ubombo.

#### 20. CYMATOCERAS cf. KOSSMATI. Spengler sp.

1910. *Nautilus (Cymatoceras) kossmati*, Spengler. "Untersuch. ü. d. Südind. Kreidef.," IV, *loc. cit.*, p. 129.

One specimen (No. 2588), representing a wholly septate cast, has a portion of the shell preserved at the diameter of 80 mm. and shows only striae of growth at that stage, but obscure folds on the ventral area of the cast of the following portion. Its dimensions are:

Diameter . . . 120 mm.

Thickness . . . 75 ., (63 per. cent. of the diameter).

The specimen is a more compressed example of *Cymatoceras* than those described above, and resembles in general appearance *C. kossmati*, but this species is strongly costate already at a considerably smaller diameter. The siphuncle in the present example is nearer the ventral side and not in the median plane.

*C. kayeanum*, Blanford sp.,§ is a still more compressed species, and is more distinctly costate on the ventral area than the specimen here described.

The Cenomanian *C. imbricatum*, Crick sp.,|| also is too compressed.

*Locality*.—Manuan Creek. Coll. Resident Magistrate, Ubombo.

\* *Loc. cit.* (1910), p. 130, pl. xi, fig. 3.

† *Loc. cit.* (1907), p. 221, pl. xiv, fig. 7.

‡ Non *Nautilus elegans* (Sowerby), in Boule, Lemoine and Thévenin, *loc. cit.* (1907), p. 66, pl. xv, figs. 4 and 5.

§ *Loc. cit.* (1861), p. 41, pl. xviii, fig. 1 (type); Spengler, *loc. cit.* (1910), p. 127, pl. xi, figs. 1 and 2, pl. xii, figs. 2 and 7 a.

|| *Loc. cit.* (1907), p. 220, pl. xiv, fig. 6.

## 21. CYMATOCERAS? cf. CLEMENTINUM, d'Orbigny sp.

1840. *Nautilus clementinus*, d'Orbigny. Pal. Franç. Ter. Crét., vol. i, p. 77, pl. xiii bis.
1861. *Nautilus splendens*, Blanford. *Loc. cit.* (Foss. Ceph. Cret. Rocks S. India), p. 21, pl. ix, fig 5, pl. x, fig. 1.
1866. *Nautilus splendens*, Stoliczka, *ibid.*, p. 205.
1910. *Nautilus cf. clementinus* (d'Orbigny) Spengler. *Loc. cit.* p. 143.

A small specimen (No. 4988), slightly worn, and showing the striae of growth on the test in one or two places, agrees with d'Orbigny's type in whorl-shape and general appearance. At a diameter of 70 mm. the thickness = 45 mm., which is less than the thickness of d'Orbigny's example, but slightly more than that of *N. splendens*, Blanford, the type of which, however, is crushed. Spengler united the two species, which may be open to objections, but since the specimen here described is not well preserved, it also is included in d'Orbigny's well-known Gault species.

Foord\* described the species in detail, and was inclined to separate the Indian from the European forms on account of their greater whorl-thickness. Spengler† has since created the var. *indica* of *N. clementinus* for the later Indian form, but the present example is much closer to the European Gault form than to the Trichinopoly species.

*Locality*.—Middle Branch, Manuan Creek. Coll. W. J. Wybergh.

## B. SENONIAN.

## AMMONOIDEA.

## GEN. PERONICERAS, Grossouvre.

## 22. PERONICERAS cf. DRAVIDICUM, Kossmat sp.

(Pl. XXIII, figs. 1 a-d.)

1865. *Am. subtricarinatus*, d'Orbigny. Stoliczka, "Cret. S. India," I, p. 54, pl. xxxi, figs. 3, 3 a-c.
1895. *Schloenbachia dravidica*, Kossmat. "Unters. S. Ind. Kreidef.," Beitr. Pal. und Geol. Öst.-Ung., vol. ix, Heft 3 and 4, p. 190 (94), pl. xxiii (ix), figs. 3 a-d.

\* *Loc. cit.* (1891), p. 285 (see there for synonymy).

† *Loc. cit.* (1910), p. 143.

1904. *Peroniceras dravidicum*, Kossmat. Solger, "Foss. d. Mungo-Kreide," Geol. v. Kamerun, II, p. 181, text-fig. 71, p. 182, and 72, p. 183.

A fragment (No. 4950), 72 mm. in length and belonging to a shell just a little larger than the inner whorls of this species, refigured by Kossmat, *i. e.*, of about 85 mm. diameter, has a whorl-height and thickness of 24 mm. It differs from the type of this species only in having the inner tubercle nearer the umbilicus and more prominent, *i. e.* projecting laterally and representing the region of greatest thickness—a character that would approach the present example more to *P. subtricariniatum*. The suture-line, however, has no independent second lateral saddle, like that of *P. subtricariniatum*, but, as in *P. dravidicum*, this second lateral saddle forms only the internal branch of the first lateral saddle, and there is a large umbilical lobe. The principal lobe, though, is deeper in the specimen here described, and the umbilical lobe shorter, than they are in Kossmat's figure. It may also be added that the internal portion of the suture-line is very variable; the stem of the umbilical branch of the dorsal saddle may be much broader than drawn, so that the details of the umbilical lobe and the size of its lower internal and higher external branch may differ considerably in consecutive suture-lines. No similar suture-line appears to have been observed in any other species of *Peroniceras*, e. g. *P. schueeblii*, Boule, Lemoine and Thévenin sp.,\* which may be a related form, occurring in Madagascar, does not show this type of umbilical lobe, nor do the two examples of *Peroniceras* recorded by Crick † from Zululand. One of these, sp.  $\alpha$  (B.M., No. C18245), compared with *P. tridorsatum*, Schlüter sp., resembles *P. czörnigi*, Redtenbacher sp.,‡ but not the "variety" figured by Grossouvre,§ and has a thinner whorl-section than the present example. Since Crick only figured the external half of the suture-line, the internal portion is here given for comparison (Pl. XXIII, fig. 2). The other example, sp.  $\beta$  (No. C18246), is much fatter, and in section and crescent-shaped costation resembles *P. rousseauzi*, Grossouvre,|| but owing to the large size of these specimens comparison with the small European types is difficult. The tricarination is less distinct in this second specimen, and the suture-line also is less well preserved, though very similar in the character of the auxiliary lobes.

\* *Loc. cit.* (ii, 1907), p. 37, fig. 20, pl. xii, figs. 2, 2 a.

† *Loc. cit.* (Third Report, 1907), pp. 226-7.

‡ *Loc. cit.* (1873), p. 105, pl. xxiii, fig. 4.

§ *Loc. cit.* (1893), pl. xi, fig. 2.

|| *Ibid.*, pl. xi, fig. 5 a, b, p. 102.

*P. westphalicum*, Schlüter sp.,\* and particularly the specimen figured by Grossouvre,† are close to the present example in ornamentation and general appearance, but the tubercles are coarser; on the other hand, in *P. tridorsatum*, Schlüter sp.,‡ and *P. moureti*, Grossouvre,§ costation is too fine and close.

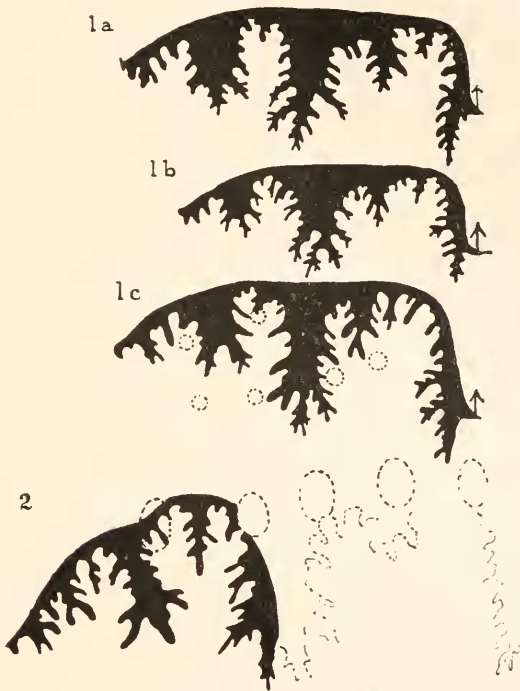


FIG. D.—1. *Mortonicerases stangeri*, Baily sp. †Upper Senonian, Umtamvuna River, Natal. 1a. Specimen No. C19444, British Museum. 1b. No. C19443, comparable with Baily's co-type No. 11368A (Geol. Soc. Coll.). 1c. No. C19440 (penultimate septum of an example 340 mm. in diameter). Figs. 1 a-c are after drawings by the late G. C. Crick. 2. *Mortonicerases* aff. *umkwelanense*, Crick. Upper Senonian, Umkwelane Hill, Zululand. (Specimen No. 5491.) (P. 234). All reduced to  $\frac{2}{3}$ .

Since *Mortonicerases stangeri*, Baily sp., has tricarinate inner whorls, and has, indeed, been included in *Peroniceras* by some writers' (e.g. Kossmat), the external suture-lines of three examples, drawn by the late G. C. Crick, and the internal portion of another example, showing

\* *Loc. cit.* (1872), p. 45, pl. xiii, figs. 5 and 6.

† *Loc. cit.* (1894), p. 98, pl. xii, figs. 1 and 4, a, b.

‡ *Loc. cit.* (1876), pl. xli, figs. 3-5, 'Jüngst. Amm.' (1867), p. 26, pl. v, fig. 1.

§ *Loc. cit.* (1894), p. 100, pl. xi, figs. 3 and 4.

good agreement with Baily's type and one of Baily's co-types (11368A),\* are here given for comparison (Pl. XXIII, fig. 3). The distinct second lateral lobe and independent second lateral saddle (on the umbilical wall) differ greatly from those of the specimen here described, though the whorl-section, at a diameter of about 25 mm., is that of a *Peroniceras*. At a stage corresponding to that of *Peroniceras* sp. ind. (in Redtenbacher: *A.* sp. indet. cfr. *A. tridorsatus*, Schlüter†), the costae of *M. stangeri* continue across the ventral area with its three faint keels, something after the style of the ventral area in *Pseudotropites ultralialisicus*, Canavari in Wähner.‡ If Baily's species is really of Upper Senonian age, as would appear from its association with *Hauericeras gardeni* and *Pseudophyllites indra*,§ it forms a striking case of convergence of a late *Mortoniceras*, characterised by its suture-line, towards the Lower Senonian *Peroniceras*.

*P. dravidicum* occurs, in India, in the Middle Trichinopoly group, which is considered to be of Coniacian (Lower Senonian) age. In Europe, e. g. the North of France,|| *Peroniceras subtricarinatum*, *westphalicum* and *moureti* occur in the zone of *Micraster cor-testudinarium*. Grossouvre¶ has all the species of *Peroniceras*, the exact horizon of which is known, in the Lower and Middle Coniacian. Boule, Lemoine and Thévenin\*\* record what appears to be the Indian species from Madagascar; Solger describes it from the Cameroons.

*Locality*.—High ground on north side of United Manuan Creek and Umsinene River, almost opposite Junction. Coll. W. J. Wybergh. The mode of preservation of this specimen (limonite, after pyrites?) is different from that of any other Zululand Ammonite that the writer has examined.

\* Baily's type of *A. stangeri* in the British Museum (Geol. Soc. Coll., No. 11366), a gigantic specimen of 325 mm. diameter, has the inner whorls corroded; the three co-types (11367, 11368 and 11368A) represent three slightly differing varieties, but the large series in the British Museum includes many transitions and shows the great variability of the species.

† *Loc. cit.* (1873), p. 125, pl. xxx, fig. 3.

‡ "Beitr. Kenntn. Tief. Zon. d. Unt. Lias N.Ö. Alp.," part vii, 'Beitr. Pal. Öst.-Ung.,' vol. ix (1894), pl. iii, fig. 1 c only.

§ According to Woods, *loc. cit.*, pp. 346-7. Two examples of *Pseudoschloenbachia unbulazi*, in the British Museum, from the Umtamvuna River, Pondoland, have impressions of large *Mortoniceras* of *stangeri* affinity, in the same pieces of matrix.

|| Pruvost, "Les Ammon. Sénon. d. Nord.," 'Ann. Soc. Géol. Nord.,' vol. xxxix (1910), pp. 365-8.

¶ *Loc. cit.* (1894), p. 106.

\*\* *Loc. cit.* (1907), p. 42 (as "*Schloenbachia (Peroniceras) subtricarinatum* d'Orb."). See also Pervinquier, *loc. cit.* (1907), p. 250.



## GEN. KOSSMATICERAS, de Grossouvre.

## SUB-GEN. MADRASITES, Kilian &amp; Reboul.

## 23. KOSSMATICERAS (MADRASITES) BHAVANI, Stoliczka sp.

(Pl. XXIV, fig. 8.)

1865. *Am. bhavani*, Stoliczka. "Cret. Fauna S. India" (Pal. Indica),

I. "Cephalopoda," p. 138, pl. lxxix, figs. 4-7.

1897. *Holcodiscus bhavani*, Kossmat. "Unters. Südind. Kreidef.,"Beitr. Pal. und Geol. Öst.-Ung., vol. xi, p. 38 (145), pl. viii (xix),  
figs. 5 and 6.

One example in the collection (No. 4909) agrees with the largest form figured by Stoliczka (fig. 6), and has the following dimensions:

Diameter . . . . . 65 mm.

Height of the last whorl . . . 40 per cent. of the diameter.

Umbilicus . . . . . 29 " " "

Thickness of the last whorl . . . 80 " " whorl-height.

Stoliczka's example has a whorl-height of 41 per cent., an umbilicus of 26 per cent. and a thickness of 77 per cent., so that it differs only in having a slightly narrower umbilicus; the umbilicus of the present example, in width, agrees more with that of the smaller form figured by Stoliczka. The inner whorls, shown in the umbilicus, are more distinctly costate than are those of either Stoliczka's or Kossmat's examples—possibly a matter of preservation.

The variety *densicostata*, Kilian and Reboul,\* is much more finely ornamented than the form here described, as are, to a lesser extent, the slightly tuberculate var. *seymouriana*, Kilian and Reboul†, *K. (M. ?) cumshewaense*, Whiteaves,‡ and the variety of the latter form figured as *Holcodiscus* cf. *H. theobaldianus*, Stoliczka, by Anderson.§ The writer has lately recognised the presence, in the Upper Senonian of New Zealand, of *Kossmaticeras (Madrasites) bhavani*, Stoliczka sp., and *K. (M.) cumshewaense* (? Whiteaves) Kilian and Reboul,|| as well as of *K. (Gunnarites)* aff. *bhavaniiforme*, Kilian and Reboul, *K.*

\* *Loc. cit.* (1909), p. 30, pl. xviii, fig. 1, pl. xv, fig. 4.† *Ibid.*, p. 29, pls. xiv, xv, xix.‡ *Loc. cit.* ('Mesoz. Foss.,' 1884), p. 208, pl. xxiv, fig. 1.§ *Loc. cit.* (1902), p. 101, pl. v, figs. 126-7. This form, however, is of Horsetown age, and Whiteaves' species also may be earlier.|| Possibly close to the incompletely known *K. (Madrasites) mcKayi*, Hector sp. ('Catal. New Zealand Court.' 1886, p. 57, text-fig. 19 a, No. 4) (misspelt *macCoyi* in Haug, "Traité," II, ii, p. 1345), that Steinmann (*loc. cit.*, 1895, p. 28) considered to belong probably to the group of *K. (M.) aemilianum*, Stoliczka sp.

(*Grossouvrites*) *gemmatum*, Huppé sp., and of *Pseudophyllites* (*Tetragonites*?) sp. juv.\*

The small *K.* (*Madrasites*) cf. *madrasinum*, Stoliczka sp., figured as *Holcodiscus* sp. by Woods,† from Pondoland, is distinguished by its pronounced umbilical tuberculation. The Madagascar form of *Kossmaticeras* (*Madrasites*) figured by Boule, Lemoine and Thévenin‡ as "*Holcodiscus theobaldinus*, Stoliczka sp. var.," differs from the form here described in having a larger umbilicus.

Crick described (in MS.) two species of *Kossmaticeras* from Pondoland as *Holcodiscus natalensis* and *H. acuticostatus*. He did not compare them with Woods' form, which is more involute, but stated that their nearest ally appeared to be *H. buddhaicus*, Kossmat—a statement with which the writer agrees. These two forms (B.M., No. C19432-3) differ little from each other, but are distinguished from the species here described by being evolute (U = 34 per cent. and 37 per cent. respectively) and by having umbilical tubercles throughout. *K.* (*Madrasites*) *fuku* and *K.* (*M.*) *africanum*, Hoepen sp., are closely similar forms§ represented in the collection from the Durban Museum.

Kilian has recorded *K. bhavani* also from New Caledonia,|| and related forms occur throughout the Indo-Pacific province, whereas the European forms recorded as *Kossmaticeras* belong to other groups than the finely-ribbed South African *Madrasites*.

*Locality*.—South side of Mauuan Creek Valley. Coll. W. J. Wybergh.

## GEN. PLACENTICERAS, Meek.

### 24. PLACENTICERAS cf. SUBKAFFRARIUM, sp. nov.

Two whorl-fragments (Nos. 4957 and 4958), possibly belonging to the same individual, appear to be identical with the species described

\* In collections kindly sent by Mr. Henry Woods, F.R.S., and by Dr. Trechmann (see 'Geol. Mag.,' n.s., dec. vi, vol. iv [1917], p. 338.)

† *Loc. cit.*, p. 336, pl. xlii, fig. 2. Kilian and Reboul (*loc. cit.*, p. 62) compare this form with the Antarctic *K. (Jacobites) anderssoni*. It may be near *K. (M.) africanum*, v. Hoepen sp.

‡ *Loc. cit.* (1906), p. 26 (vol. ii), pl. vii, fig. 3 (vol. i).

§ "Descr. of some Cret. Amm. from Pondoland," 'Ann. Transvaal Museum,' vol. vii, pt. ii (1920), p. 144, pl. xxv, figs. 3 and 4, and pl. xxvi, figs. 1 and 2; p. 146, pl. xxvi, figs. 3-5.

|| There is a specimen of a *Kossmaticeras (Madrasites) bhavani* (Stoliczka), var. *densicostata*, Kilian and Reboul, in the British Museum (No. C1536) from St. Vincent, West Coast (Bourail), New Caledonia.

from Umkwelane Hill (see p. 247), and the slight differences between the fragments themselves and the figured specimen (Pl. XXI, fig. 2) may be due to weathering. The ornament thus appears perhaps more distinct, after the style of *P. intercalare*, Meek, and the periphery may be just a trifle narrower. Like the type, these two examples differ from *P. tamulicum*, Blanford sp., chiefly in being fatter in the umbilical region. The suture-line is worn, but its plan agrees with that of the Indian species.\*

*Locality*.—South side of Manuan Creek Valley. Coll. W. J. Wybergh.

## NAUTILOIDEA.

### GEN. CYMATOCERAS, Hyatt.

#### 25. CYMATOCERAS? sp. cf. JUSTUM, Blanford sp.

1861. *Nautilus justus*, Blanford. "Cret. Fauna S. India" (Pal. Indica), vol. i, "Cephalop.," p. 22, pl. x, figs. 2-3.

? 1861. *Nautilus bouchardianus* (d'Orbigny) Blanford, pars. *Ibid.*, pl. iv, fig. 3 only.

1866. *Nautilus justus* (Blanford) Stoliczka. *Ibid.*, p. 206, pl. xciii, fig. 2.

1910. *Nautilus justus* (Blanford) Spengler, "Untersuch. ü. d. Südlind. Kreideform., pt. iv, Die Nautil. und Bel. d. Trichinopoly Distr.," Beitr. z. Pal. und Geol. Öst.-Ung., vol. xxiii, pt. iii, p. 142, pl. xiv, fig. 3.

A small specimen (No. 4935) agrees with one of the examples described by Crick† as *Nautilus* (? *Eutrephoceras*) sp., both in whorl-shape and elegant ornamentation, as in the mode of preservation (brown limonite coating), but on account of its annular lobe and *elegans*-like (if fine) striation is referred to *Cymatoceras*. At a diameter of 40 mm. the whorl-thickness is 30 mm.; the siphuncle is central and the umbilicus not quite closed.

Spengler thought Crick's *Nautilus* [*Cymatoceras*?] *occlusus* to be close to the species here discussed, but the latter is less globose. *Cymatoceras kossmati*, Spengler sp.,‡ agrees in whorl-shape, but the costation is much coarser, as it also is in the Utatur species *C. kayeanum*, Blanford sp.

\* Fig. 1 c of pl. xxii, in Kossmat, *loc. cit.*, 1895.

† *Loc. cit.* (1907), p. 245, B.M., No. C18293.

‡ *Loc. cit.* (1910), p. 129 (*N. pseudo-elegans*, d'Orbigny in Blanford, *loc. cit.*, 1861, p. 33, pl. xviii, fig. 3).

This specimen is the only one in the collection from "High Ground, South Side of South Branch of Manuan Creek, just below Wagon-Drift." Coll. W. J. Wybergh. Its assumed Senonian age thus is not supported by Ammonite evidence, and its mode of preservation is distinct from that of any of the other specimens in this collection.

#### OBSERVATIONS ON THE MANUAN CREEK FAUNA.

The relations of the Manuan Creek fauna have been discussed in detail by Crick and Newton, but it has been mentioned in the introductory part of this paper that the presence of Albian, Cenomanian and Lower and Upper Senonian forms was not clearly recognised, so that a revision of the faunas has become necessary. With regard to the Ammonoids, the few Senonian forms here described have already been referred to in the observations on the Umkwelane Hill fauna. They include the Coniacian—

*Peroniceras* cf. *dravidicum*, Kossmat sp.,

to which have to be added the two *Peroniceras* recorded by Crick, with the Cenomanian False Bay fauna, and here referred to on p. 296, namely:

*Peroniceras* cf. *czörnigi*, Redtenbacher, sp.

*Peroniceras* cf. *rousseaui*, de Grossouvre.

To the presumably Campanian Ammonites described in this paper, namely,

*Kossmaticeras* (*Madrasites*) *bharani*, Stoliczka sp.

*Placenticerias* cf. *subkajjirani*, nov.

must be added the following forms described by Crick from the South Branch of the Manuan Creek:

*Gandryceras pulchrum*, Crick.\*

*Gandryceras* cf. *kayei*, Forbes sp. [*Gandryceras* sp. in Crick, p. 238.]

*Diplomoceras* ? sp. [*Anisoceras* sp. in Crick, p. 239.]

*Baculites* cf. *capensis*, Woods [*Baculites* sp. in Crick, p. 240.]

*Hauericeras* sp.†

The Upper Senonian fauna of the Manuan Creek District thus shows a greater resemblance to the fauna of the Umzamba Group of Pondoland (so-called Umtamvuna Beds) than to the Umkwelane Hill fauna, which is much nearer, geographically, but which represents a different facies.

\* *Gandryceras* sp. (p. 239 in Crick) probably is a badly weathered fragment of this species.

† P. 242, pl. xv, fig. 5, the inner whorls erroneously being represented as having an acute venter. For *Hauericeras* sp. (p. 243), see above, under *Uhligella* sp. n. cf. *stoliczkai*, Kossmat sp. (p. 276, footnote †).

*Acanthoceras* sp. (in Crick, p. 241), comparable with *A. latum*, Crick, and *A. quadratum*, Crick, is of Cenomanian age, like the "False Bay" fauna described by Crick. The resemblance of this fauna to that of Northern Africa on the one hand and India on the other was noticed by Pervinquière,\* who thought it quite evident that inter-communication between these areas must have been easy.

There is, then, evidence in the Manuan Creek district of the presence of deposits of Albian, Cenomanian, Lower Senonian (Coniacian) and Upper Senonian (Campanian, incl. Maestrichtian?) age. The first of these formations, perhaps, is the most important, and of Crick's Manuan Creek Ammonites the following probably belong to it:

*Phylloceras* sp. (p. 236) [identical with *Ph. velledae*, Michelin sp., described in this paper].

*Lytoceras crenulatum*, Crick (p. 236).

*Schloenbachia* sp. (p. 240) [probably *Pseudophacoceras manuanense*, nov.].

*Desmoceras* sp. (p. 241) [*Latidorsella*? sp. ind.].

"*Hauericeras*" sp. (p. 243) [probably *Uhligella* sp. n. cf. *stoliczkae*, Kossmat sp.].

A second specimen of a "*Hauericeras*"? sp. and a "? *Beudanticeras beudanti*" also probably belong to this last form, and other, unrecorded, specimens from the South Branch of the Manuan Creek in Crick's collection are:

*Anisoceras* sp.

*Douvilleiceras* sp.

"*Schloenbachia* aff. *delaruei*, d'Orbigny sp." [*Dipoloceras* sp.].

All the forms recorded by Crick from the Middle Tributary of the Manuan Creek, also, probably, are of Albian age, namely:

*Puzosia concinna*, Crick (p. 245).

*Puzosia compacta*, Crick (p. 246).

*Schloenbachia* sp. (p. 247) [*Dipoloceras* sp.].

*Hysterocheras* sp. (p. 248) [*Braucoceras* sp.].

These Albian forms allow of more exact correlation. Including those described by Etheridge from the Umsinene River (the types of which, however, the writer has not examined), the list of Albian Ammonoids, then, is as shown in Table I.

The forms mentioned in this list indicate that probably the Middle Albian (*mammillatum*, *delaruei*, and *crisatum* zones), and the Upper Albian, up to the upper *rostrata* zone above, are represented, the latter zone apparently transitional to the Lower Cenomanian, exposed near

\* "Amm. d. Crét. Algér.," 'Mém. Soc. Géol. France,' Pal., vol. xvii, No. 42 (1910), p. 81.

TABLE I.—*Albian Ammonoidea from the Manuan Creek District.*

	Page.	Identical or allied species.	Europe.	Tunis.	Madagascar.	India.	Other countries.	Suggested horizon.	Remarks.
1. <i>Phylloceras velthedae</i> , Michelin, sp.	M. 273	<i>P. velthedae</i>	x	x	x	x	Conducia? California?	(Albian)	Incl. <i>Phyl.</i> , sp. Crick, p. 236. Crick, p. 236.
2. <i>Lophoceras circumlatum</i> , Crick.	S. 303	<i>L. mahadera</i> , Stoliczka sp.	—	—	—	—	—	" <i>rostrata</i> ?"	—
3. <i>Puzosia cf. bhina</i> , Stoliczka sp.	M. 274	<i>P. bhina</i>	—	—	?	—	—	(Albian)	Etheridge, p. 88.
4. " sp. ( <i>Desmoereras</i> sp. Etheridge)	U. 276	<i>P. of planulata</i> group	—	—	x	—	—	"	—
5. " <i>concinna</i> , Crick.	M. 275	"	x	?	—	?	—	"	Crick, p. 245.
6. " <i>compacta</i> , Crick	M. 275	<i>P. octosulcata</i> , Sharpe sp.	—	—	?	—	Persia	" <i>rostrata</i> ?"	Incl. <i>B.?</i> <i>bendanti</i> (Crick, in Coll.), and <i>Hamericeras</i> , sp. Crick, p. 243.
7. <i>Uhligella?</i> sp. n. aff. <i>stoliczkae</i> , Kossmat sp.	M. 275	" <i>A. bendanti</i> ," Stoliczka	—	—	?	x	—	"	—
8. <i>Latidorsella?</i> sp. ( <i>Desnoc.</i> sp., Crick)	S. 303	<i>Desnoceras inane</i> (Stol.)	—	—	—	x	—	(Albian?)	—
9. <i>Douvilletceras</i> sp. (Etheridge)	U. 220	<i>D. mammillatum</i> (Schloth.)	x	—	x	—	Angola Brazil	<i>mammillatum</i>	Crick, p. 241. Etheridge, p. 87. Crick, in Coll.
10. " sp. (Crick, in coll.)	S. 220	"	x	—	—	—	Nigeria	" <i>cristatum</i>	—
11. <i>Diploceras cristatum</i> , Deluc sp.	C. 277	<i>D. cristatum</i> (Deluc)	x	x	—	—	"	"	—
12. " <i>quadratum</i> , sp. nov.	M. 278	<i>A. bonchardianus</i> (Pictet)	x	x	x	—	Mexico	"	Böse, p. 74, pl. viii, f. 6.
13. " sp. nov.	M. 280	<i>Schloenbachia</i> , n. sp.	—	—	—	—	S. America	"	Crick, p. 247, and Coll.
14. " sp. ( <i>Schloenbachia</i> , Crick)	M.S. 220	<i>D. cristatum</i> (Deluc)	x	—	—	—	N. and S. America	"	Incl. " <i>Sphenodiscus</i> , sp.," B.L.T. and <i>Schloenbachia</i> sp., Crick, p. 240.
15. <i>Pseudophacoceras manuanense</i> , sp. nov.	C. 281	<i>P. multipitum</i> (Steinmann)	—	—	?	—	—	"	—
16. <i>Subschloenbachia pterostrata</i> , nov.	M. 284	<i>S. inflata</i> , auct.	x	?	x	—	—	<i>varicosum</i>	—
17. " cf. <i>trinodosa</i> (Böse)	V. 285	<i>S. trinodosa</i> (Böse)	x	?	?	?	Mexico	<i>rostrata</i>	—
18. " <i>bispinosa</i> , sp. nov.	M. 285	<i>S. inflata</i> , auct.	x	—	—	—	Queensland	<i>varicosum</i>	—
19. <i>Brancoceras</i> sp. ( <i>Hysteroeras</i> , Crick)	M. 303	<i>B. varicosum</i> , auct.	x	x	x	—	S. America	" <i>cristatum</i> ?"	Crick, p. 248.
20. <i>Ligelloceras nodosum</i> , Etheridge sp.	U. 220	<i>L. tyleri</i> (Desh. in Leym.)	x	—	—	—	Angola, Texas	<i>rostrata</i>	Etheridge, p. 87.
21. <i>Stoliczkaia</i> sp. ind.	V. 286	<i>S. clarigera</i> , Neumayr	?	?	?	x	Angola	(Albian)	—
22. <i>Tornetoceras</i> sp. ind.	V. 288	<i>Hamiites virgulatus</i> , auct.	x	x	?	?	—	" <i>rostrata</i> ?"	—
23. <i>Anisoceras</i> sp. ind.	L. 288	<i>Helicoc. thurmanni</i> (P. & C.)	x	?	?	?	—	"	Crick, in Coll.
24. " sp.	S. 288	<i>Anisoceras alternatum</i> (M.)	x	?	?	?	—	"	—
25. <i>Turritites</i> cf. <i>gresslyi</i> , P. and C.	V. 289	<i>Turrit. gresslyi</i>	x	?	x	?	Conducia?	"	—

M. = Middle Tributary of the Manuan Creek. S. = Southern Tributary of the Manuan Creek. C. = Manuan Creek. V. = South side of Manuan Creek Valley.  
 U. = Umsine River. L. = Isolated locality further north.



the junction of the Umsinene River and the Manuan Creek. These horizons of the Upper and Upper Middle Albian, according to the succession tentatively suggested by the writer in his description of the Albian fauna of Angola, appear to be:

Upper <i>rostrata</i> horizon	. . .	"post-rostrata" (XIII, XII).*
Lower " " "	. . .	"rostrata s.s." (XI).
Upper <i>varicosum</i> horizon	. . .	"prerostrata" (X, IX b).
Lower " " "	. . .	"bouchardianum" (IX a).
Upper <i>cristatum</i> "	. . .	"cristatum s.s." (VIII).
Lower " " "	. . .	"corvatum" (VII, VI).

It is to be hoped that further collecting will be done, with a view to tracing the succession of the Manuan Creek Albian in detail and elucidating the somewhat uncertain relations of, *e. g.*, the outcrop of the "Umsinene deposit," exposed chiefly in the bed of the southernmost tributary of the Manuan Creek† and apparently comprising Middle Albian and Campanian forms, with the neighbouring Comiacian and Cenomanian exposure near the junction of the Umsinene River and the Manuan Creek. It may be added that the forms of the highest Albian (upper *rostrata* zone, with *Stoliczkaia*) all come from one locality, namely the "south side of the Manuan Creek Valley" (V in the list), and that none of the other localities apparently have yielded examples that are referable to this highest Albian. In the case of the *Lytoceras* and the Desmoceratids (2, 3 and 7 in the list), the comparison with Indian species might suggest a high horizon in the Albian, only the top of this formation, apparently, being found in India; but the Ammonites probably are not specifically identical. On the other hand, it is just these forms that connect the Zululand fauna with the types special to the Indo-Malgasian Province, for nearly all the remaining Ammonites correspond with well-known European types, with the exception of *Pseudophacoceras manuanense* and of *Dipoloceras sp. nov.*, which are more closely comparable with American‡ species, and which, *e. g.* in Mexico, occur several hundred feet below the equivalent of the *rostrata* zone. The writer, in another place, when discussing the relations of the Angola fauna, referred to the probable immigration of these elements into the African region from South America along the southern edge of

\* These numbers refer to the beds at Folkestone.

† Anderson, *loc. cit.* (Third Report, 1907), p. 58.

‡ Lemoine ('Pal. Nord. Madagascar,' 1906, pp. 204-5) recorded "*Schloenbachia roissyi* (= *Schl. acuto-carinata*, Shumard)" and "*S. mirapeliiana*, d'Orbigny sp. (= *S. buarquiana*, White sp.)," but in the following year, Boule, Lemoine and Thévenin described a *S. (Mortonicerus) cf. inflatiformis*. Szaļņocha, which probably is a *Subschloenbachia*, whereas their "Lower Cenomanian *Sphenodiscus*" may be a *Pseudophacoceras*, allied to *P. manuanense* and *P. buarquianum*.

the Africano-Brazilian Continent ("Brasilia"), whereas undoubtedly there also was free and direct communication through the Channel of Mozambique and the Sea to the North with the Mediterranean. That a larger number of forms are common to the European and the Zululand Albian, than to the latter, and *e.g.* the fauna of Tunis, probably is partly due to the fact that this formation has been much more thoroughly explored in Europe, and the Middle and Lower Upper Albian of North Africa, are still incompletely known.

It is interesting to note that the South Queensland forms of *Subschloenbachia*, described by Etheridge, are more closely allied to Zululand than to Indian forms; but since similar types occur again in Europe and in Mexico, perhaps no significance may be attached to this. Moreover, some of the Queensland forms appear to belong to the *prerostata* horizon, which, probably, is not represented in Southern India, the lowest Utatur Beds, according to Kossmat, including *Stoliczkaia* and *Mantelliceras*, in addition to *Subschloenbachia*, and such forms as *Prohysteroceus propinquum* and *Neokentroceus* (gen. nov.\*) *gracillimum*, Kossmat sp. On the other hand, *Dipoloceras* of the *cristatum* group, and *Subschloenbachia* have now been found in Nigeria, and the genera *Douvilleiceras*, *Subschloenbachia*, *Brancoceus* (?), *Stoliczkaia*, also *Desmoceratidae* and *Hamitidae* occur in Angola; yet, it may be held with Boule, Lemoine and Thévenin† that "the resemblances with West Africa (Angola) are feeble, and it seems . . . that West Africa formed part of another zoological province." This latter is characterised by the special genus *Elobiceras*‡ and the group of *Subschloenbachia evoluta*, nov., found only in Nigeria, the Elobi Islands, and Angola, possibly also in Tunis, whereas, as has been mentioned, the large *Lytoceus*, found again in Pacific regions, and certain *Desmoceratids*, connect the Zululand fauna with the special developments of the Indo-Malgasian Province. On the other hand, easy communication with the Mediterranean facilitated extensive faunal equalisation during the Aptian and Albian, extending to South America along the Northern§ and Southern shores of the Africano-

\* A post-*Subschloenbachia* development (Genotype = *N. curvicornu*, nov. from Angola, allied to *N. tectorium*, White sp.).

† *Loc. cit.* (1907), p. 72.

‡ Gen. nov. (Genotype = *Schloenbachia clobiensis*, Szajnocha, 1885, pl. iv, fig. 1). Described fully in the writer's Angola paper.

§ The westward extension of the Tethys is indicated by the close correspondence with European developments shown by the Upper Jurassic of Mexico, the Lower and Middle Cretaceous of Venezuela and Colombia, the "Gosau facies" of Jamaica and Mexico, etc. (see Suess, 'Face de la Terre,' vol. iii, pt. iv, p. 1680). An arm of this sea reached south as far as Angola.

Brazilian Continent.\* That the latter was still in existence in Upper Senonian times appears to be indicated by the extremely close resemblance of the *Kossmaticeras*-beds of Pondoland with those of Antarctica, Southern Patagonia, Chili and New Zealand, all of which are largely made up of glauconitic, calcareous sandstones, and apparently pass uninterruptedly into the lowest tertiaries.†

The lower Albian beds (Clansayes horizon) that bridge over the gap between the Aptian fauna of Powell's Camp and the *mammillatum*-zone of the "Umsinene River deposit," if present at all, have not yet yielded Ammonites.

#### IV. AMMONOIDEA FROM ISOLATED LOCALITIES.

##### A. NORTH-WEST SHORE OF FALSE BAY.

The present collection only includes two specimens from this locality (Coll. W. J. Wybergh) namely :

*Mortonicerus vanuxemi*, Morton sp.

*Bostrychoceras?* sp.

They are preserved in a brownish, marly sandstone, very friable, and thus different from the matrix of Crick's Cenomanian fauna, but this difference may partly be due to weathering. On the other hand, *M. vanuxemi* can definitely be dated as Campanian (zone of *M. delawarensis*),‡ and the other specimen, as well, is comparable with a Pondoland form, considered by Woods to be of Campanian age. The outcrops of these beds along the north-western edge of False Bay are referred to by Mr. W. Anderson in the Second§ and Third Reports|| of the Geological Survey of Natal and Zululand. Crick¶ assumed that this was the locality from which the fossils were obtained that he described under the title of "The Cephalopoda from the Deposit at the North End of False Bay, Zululand." According to Mr. W. Anderson, however,\*\* these Cenomanian Ammonites came from the river-bank near the

\* Engler ("Üb. Florist. Verwandtschaft zw. d. Trop. Afr. und Am., etc.," Sitz. K. Preuss. Ak. Wiss. Berlin, 1905, i, p. 229) deduced the existence of large islands or a continent connecting Brazil with Africa from a study of the existing flora.

† See in O. Wilckens, "Die Kreideform. v. Neu-Seeland," 'Geol. Rundschau,' vol. xi (1920), pp. 189-91.

‡ Haug, 'Traité de Géologie,' II, ii, p. 1170.

§ 1904, p. 48.

|| 1907, p. 57.

¶ *Ibid.*, p. 164.

\*\* 1907, p. 60. See also Crick ('Geol. Mag.,' August, 1907), p. 344.

junction of the Manuan and Umsinene Rivers, whereas from the western bank of False Bay he only "obtained some fragmentary fossils, very badly preserved, which Mr. Etheridge was inclined to think belonged rather to the Tertiary than to the Cretaceous System."\*

GEN. MORTONICERAS, Meek.

1. MORTONICERAS VANUXEMI, Morton sp.

(Pl. XXIII, figs. 4 a, b.)

1892. *Mortoniceras vanuxemi* (Morton), Whitfield. "Gast. and Ceph. Raritan Clays," Mon. U.S. Geol. Surv., vol. xviii, p. 252, pl. xlii, figs. 3-4.

1907. *Mortoniceras delawareuse* (Morton), Stuart Weller. Rep. Cret. Pal. New Jersey, vol. iv, Pal. Ser., p. 837, pl. civ, figs. 4-5 only, non pl. ciii.

A fragmentary specimen (No. 4947), showing interlocking suture-lines and an impression of portions of the inner whorls, agrees with the above figures and undoubtedly belongs to this species, which is distinguished from its close ally *M. delawareuse*, Morton sp., by being more compressed and less coarsely ornamented. The suture-line is of the same type as those of *M. woodsi* (Pl. XXI, fig. 1 c) and *M. soutoni* (Baily) (Pl. XX, fig. 4) figured in this paper, but differs in the terminal branches of the lateral lobe, which is perhaps due to the interlocking of the (last few?) suture-lines.

*M. woodsi*, nov., is an extreme development of *M. vanuxemi*, with overhanging umbilical edge and fine and close ornament.

GEN. BOSTRYCHOCERAS, Hyatt.

2. BOSTRYCHOCERAS, ? sp.

1906. *Heteroceras* sp., Woods. "Cret. Fauna of Pondoland." Ann. S. Afr. Mus., vol. iv, pt. vii, No. xii, p. 339, pl. xlii, fig. 4.

A small fragment (No. 4952), about 28 mm. in length, belongs to the form described by Woods and has four intermediate ribs between the flares, but it is too fragmentary to determine whorl-shape and coiling. The reasons for referring the form to *Bostrychoceras* are discussed under *B.?* sp. nov. (p. 252) of the Umkwelane Hill fauna. *Hamites* sp., described and figured by Jimbo,† seems to belong to a

\* *Ibid.*, p. 57.

† *Loc. cit.*, p. 40, pl. ix, fig. 1 only.

similar form. Woods noted the resemblance of this form to *Hyphantoceras reussianum*, d'Orbigny sp.; *H. flexuosum*, Schlüter sp.,\* and *H. sp. nov.* (= *Heteroceras sp.* in Woods),† are other species of the genus *Hyphantoceras* that show superficial resemblance, but are of Turonian age.

The example is distinguished from the *B. ? sp. ind.*, found at Umkwelane Hill (p. 255), by having coarser costation and four, not three, intermediate ribs, so that at a similar whorl-height the flares are about twice as far apart in the present form.

#### B. POWELL'S CAMP, UPPER CATEMBE, PORTUGUESE EAST AFRICA.‡

The three Ammonites from this locality (Nos. 5117-19) are preserved, as casts, in a light yellowish-grey, calcareous sandstone, and two of them show portions of the test. This matrix, stained yellow with rust in places, is not unlike the lighter-coloured portions of the calcareous sandstones of Umkwelane Hill, and apparently is similar to that of the Aptian fauna of Delagoa Bay, recorded by Kilian§ and described by Krenkel.||

The three forms described below are—

*Aconeceras nisoides*, Sarasin sp.

*Chelonicerus gottschei*, Kilian sp.

*Chelonicerus (Acanthoplites ?) delagoense*, Krenkel sp.

The assemblage, thus, is the same as that recorded from Delagoa Bay, of the same sandy, littoral facies, and undoubtedly of Aptian age. Dr. Kitchin¶ has already referred to this Aptian fauna from Delagoa Bay in his important memoir on the Uitenhage Beds.

Krenkel was of opinion that the Bedoulian (Lower Aptian) as well

\* *Loc. cit.*, p. 108, pl. xxxii, figs. 10-12.

† 'Q. J. G. S.', vol. lii (1896), p. 75, pl. ii, figs. 7 and 8.

‡ When writing this account, the author was under the impression that Powell's Camp was in Zululand, but it now appears that though its exact position and the meaning of "Upper Catembe" are unknown, it may be in the neighbourhood of Delagoa Bay, Catembe being marked on Jeppe's map as being on the right bank of the Tembe river, some five miles from the mouth.

§ "Üb. Aptian in S. Afr.," 'Centralbl. f. Min.,' August, 1902, p. 465; also 'Bull. Soc. Géol. France' (4), II, 1902, p. 358; and 'Comptes Rendus,' cxxxv, No. 1, (July 1902), pp. 68-71.

|| "D. Aptfossil. d. Delagoa Bai," 'N. Jb. f. Min., etc.,' 1910 (I), pp. 142-168, pl. xvii.

¶ "The Invertebr. Fauna and Pal. Rel. of the Uitenhage Ss.," 'Ann. S. Afr. Mus.,' VII, pt. ii, No. 3 (1908), p. 57.

as the Gargasian (Upper Aptian) were represented in the Delagoa Bay fauna, and he considered "*Oppelia*" *nisus* (d'Orbigny) to be a typical representative of the latter division. Haug\* has a zone of "*Oppelia*" *nisus* above the zone of "*Parahoplites*" *deshayesi* and *Ancyloceras matheronianum*, which includes the whole of the Bedoulian, but v. Koenen† records "*Oppelia*" *nisoïdes*, indistinguishable from the example here described, from the zone of "*Parahoplites*" *weissi*, which constitutes his lowest Aptian, below the *deshayesi* zone. Kilian‡ considered that the occurrence of *Aconeceras nisum* in the Upper Aptian (Gargasian) of the South of France indicated a migration of this genus from north to south, but it seems to the writer that the range in the Aptian of this form and of its close allies, like *A. nisoïdes*, is not yet known.§

It has to be noted in this connection that the suture-lines of the two forms of *Chelonicerias* agree with that of *Ch. cornuelianum* (d'Orbigny) much more than with those of the *Acanthoplites* of the *bigoureti* group; and *Ch. cornuelianum* is put into the Lower Aptian both by Kilian|| and by R. Douvillé,¶ whereas, according to Haug,\*\* at la Bedoule, *Ch. cornuelianum* occurs both in the lower Aptian, *i. e.* in the true Bedoulian, and in the higher division (Gargasian), and it is associated with "*Oppelia*" *nisus* also at other localities.††

The relations of the Delagoa Bay fauna with those of other parts of Africa, of Madagascar, India, etc., were ably discussed by Krenkel in the paper quoted above, and in another memoir on the Lower Cretaceous of East Africa.‡‡ Zwietycki§§ later described a fauna, from doubtful localities in East Africa, that included *Acanthoplites* (?) *rauïji*, Zwietycki sp., and *Diadochoceras nodosocostatum*, d'Orbigny sp. The former is compared with *Chelonicerias cornuelianum*, and only differs from the example here described as *Ch. gottschei* in retaining bituberculation to a larger diameter; but it probably is an *Acanthoplites* of the

\* *Traité*, II, ii, p. 1170.

† "Amm. d. Nordd. Neoc.," 'Abh. K. Pr. Geol. L.A.,' N.F., Heft. 24 (1902), p. 51.

‡ In *Lethaea Geogn. II, Mesoz. 3, Kreide, I, 3, 1913*, p. 338.

§ In his latest paper ('*Trav. Lab. Géol. Univ. Grenoble*, vol. xii [1919], p. 94), Kilian has *A. nisoïdes* as Gargasian.

|| *Loc. cit.* (1910), p. 281.

¶ 'Pal. Univers.,' 1911, No. 209.

\*\* *Loc. cit.*, p. 1198.

†† *E.g.* pp. 1183, 1191, *loc. cit.* (Haug).

‡‡ 'Beitr. Pal. Öst.-Ung.,' vol. xxiii (1910), pp. 230-250.

§§ "D. Ceph. d. Tendaguru-Sch. i. Deutsch. O. Afr.," 'Wiss. Erg. d. Tendag. Exp., 1909-12,' pt. iii, 'Arch. f. Biontol.,' 1914, vol. iii, pt. 4.



lower Clansayes horizon = Zone III in Jacob.\* Kilian† also puts this horizon as the base of the Albian, but Haug‡ has the Clansayes Beds (= "zone of *D. nodosocostatum*") as the uppermost Aptian. At any rate, this East African fauna described by Zwietzycki includes higher horizons than do the Aptian faunas of Delagoa Bay and of the present locality.

If the latter come from one horizon, then it is probable that this corresponds with what is called the *furcatus*-zone (?) in the table below. Stolley§, probably wrongly, quoted *Ch. cornuelianum* from his "Middle Gault" zone 1, which misled the writer when drawing up the correlation notes, kindly inserted by Mr. L. Dudley Stamp in the "Report of Excursion to Tilburstow Hill and Nutfield."|| The correlation with Stolley's horizons of the Upper Aptian, therefore, has here been corrected:

Upper Albian	. Hor. IX-XIII (Folkestone)	. Hor. 7 (Stolley) VI (Jacob).
	(Upper Gault)	
Middle Albian	{ Hor. I-VIII (Folkestone)	. ,, 6 . . . V
	(Lower Gault)	
	{ 'mammillatum bed.'	
Lower Albian	{ <i>tardefurcata</i> z. { <i>regularis</i> subz.,	. ,, 5 } . . . IV
	{ <i>milletian.</i> ,,	. ,, 4 } . . .
	{ <i>nodosocostat.</i> z. { <i>jacobi</i> ,,	. ,, 2 } . . . III
	{ <i>nolani</i> ,,	. ,, 1 } . . .
Upper Aptian	{ <i>subnodosocostatum</i> z. . . . .	. ,, 5 . . . IIb
(Gargasian)	{ <i>furcatus</i> z. (?) . . . . .	. ,, 4 . . . Ha
Lower Aptian	{ <i>deshayesi</i> z. . . . .	. ,, 3 } . . .
(Bedoulian)	{ <i>veissi</i> z. . . . .	. ,, 2 } . . . I
	{ <i>bodei</i> z. . . . .	. ,, 1 } . . .

GEN. ACONECERAS, Hyatt, 1903.

I. ACONECERAS NISOIDES, Sarasin sp.

(Pl. XXVI, figs. 4 a, b, text-fig. B 9, p. 241.)

1893. *Oppelia nisoides*, Sarasin. "Étude s. l. *Oppelia*, etc.," Bull. Soc. Géol. France (3), vol. xxi, p. 155, pls. iv-vi, figs. 10 a-c, text-figs. 3 and 5 (p. 154).

1902. *Oppelia nisoides*, Sarasin. V. Koenen, "Amm. d. Nordd. Neocom.," Abh. K. Pr. Geol. L. A., N.F., Heft 24, p. 51, pl. xlv, figs. 2 and 3.

\* *Loc. cit.* (1907), pp. 296-306.

† *Loc. cit.* (1913), p. 341.

‡ 'Traité,' p. 1199.

§ "Die Glied. d. Nordd. Unt. Kreide," 'Centralblatt f. Min.,' 1908, p. 242.

|| 'Proc. Geol. Assoc.,' 1921, vol. xxxii, pt. 1, pp. 30-32.

1913. *Adolphia nisoides*, Kilian. "Lethaea Geognostica. II, Mesoz.," 3, I, 'Unterkreide,' fasc. 3, pp. 337-8.

A completely septate specimen (No. 5119), with the suture-lines well shown, has the following dimensions :

Diameter	.	.	.	.	39.5 mm.
Height of last whorl	.	.	.	.	53 per cent. of the diameter
Thickness	„	„	.	.	23 „ „ „
Umbilicus	.	.	.	.	11 „ „ „

Being a cast and slightly worn, the specimen has the fine ornament, which distinguishes the species from *A. nisum*, d'Orbigny sp., only preserved in one or two places, and near the umbilicus, but there is very good agreement in all characters with Sarasin's type. Krenkel's\* Delagoa Bay specimen (*Oppelia nisus*) agrees with the present example in smoothness and in whorl-section.

The hollow keel is the important distinguishing feature of this form from the flat and smooth examples of *Pseudoschloenbachia*, e.g. *P. griesbachi*, Crick (M.S.) sp.† which have a very similar suture-line (compare figs. B8 and B9, p. 241), but less parallel sides, and which are of Senonian age.

Hyatt's genus *Aconecerast*‡ has priority before Stolley's *Adolphia*,§ and Hyatt may have been right in assigning this genus to *Desmocerastidae*. It probably has nothing to do with *Oppelidæ*.

## GEN. CHELONICERAS, Hyatt, 1903.

### 2. CHELONICERAS GOTTSCHKEI, Kilian sp.

(Pl. XXVI, figs. 1 a-d.)

1902. *Acanthoceras (Parahoplites) martini*, d'Orbigny sp., var. *gottschei*.

Kilian, "Apt. i. Südafr.," Centralbl. f. Min., etc., p. 465.

1910. *Douvilleiceras martini*, var. *gottschei*, Kilian. Krenkel, "Apt-foss. d. Delagoa Bai," N. Jb. f. Min., etc. (I), p. 144, pl. xvii, figs. 4, 5, 8, 9.

\* *Loc. cit.*, p. 142, pl. xvii, figs. 1 a and b, and p. 164.

† = *A. umbolazi*, Griesbach ('Q.J.G.S.,' vol. xxvii [1871], p. 63, pl. iii, fig. 1), non *A. umbolazi* Baily (B.M., No. C19428), a smooth form of 103 mm. diameter, with the greatest whorl thickness at the middle of the side, not near the umbilical border, as in *A. umbolazi*, *typus*; with umbilical tubercles, but no costation, and with faint constrictions, like *P. papillata*, G. C. Crick (M.S.) sp.

‡ 'Pseudocerastites,' 1903, p. 100.

§ "Üb. Nordd. Æquival. Clansayes Fauna, etc.," 'Centralbl. f. Min.,' 1907, p. 269 (foot-note).

A specimen (No. 5117) of 72 mm. diameter, with only the body-chamber portion (occupying three-quarters of a whorl) well preserved, and with the inner whorls largely replaced by crystalline calcite, has the following proportions :

Height of the last whorl	.	38	per cent. of the diameter
Thickness	.. .. .	47	.. .. .
Umbilicus	. . . . .	35	.. .. .

The coronatiform innermost whorls (diameter = 4 mm.) have a depressed whorl-section with prominent lateral spines and constrictions, like the ammonite next described, and like *Chelonicerus royerianum*, d'Orbigny sp. The following stage, represented by Krenkel's figures, and comparable with Sinzow's examples of *Ch. seminodosum* (Sinzow) and *Ch. meyenendorffi* (d'Orbigny),\* is badly preserved. Only the first prominent rib, at the beginning of the well-preserved body-chamber portion, has a lateral tubercle, in addition to the umbilical one, so that there is loss of the characteristic bituberculation, as stated by Krenkel, and as shown in the specimen of "*D. cornuelianum*" figured by Kilian.† The latter, however, has lost the umbilical tubercle, as well as the lateral one, whereas in the form here described this umbilical tubercle remains distinct on some of the longer ribs, which feature approaches the present example to *Ch. albrechti-austriacae* (Hohenegger), Sinzow sp.,‡ to *Ch. tschernyschewi*, var. *laticosta*, Sinzow sp.,§ and to other forms of the *cornuelianum* group.||

On account of the imperfect condition of the present example,¶ identification with Kilian's form, or with any of the other species of the *cornuelianum* group, is, perhaps, impossible, but though *Ch. gottschei* was only figured in small examples, it appears probable that the present specimen represents the adult stage of that form, showing "decline" of the costation, as does *Ch. meyenendorffi* (d'Orbigny) in Sinzow.\*\* The present example, at any rate, is closer to the

\* "Beschr. einiger *Douvilleicerus*-Arten a. d. Ob. Neocom. Russl.," 'Verh. Russ. Kais. Min. Ges.' (ser. 2), vol. xlv (1906), pl. i, figs. 6 and 8.

† *Loc. cit.* (1913), p. 339, pl. ix, fig. 3.

‡ *Loc. cit.* (1906), pl. iv, figs. 1 and 2, and Kilian, *loc. cit.* (1913), pl. viii, fig. 2.

§ *Ibid.*, p. 187, pl. iii, fig. 1, and Kilian, *loc. cit.* (1913), p. 340, pl. ix, fig. 5.

|| A specimen in the British Museum (No. 46590), from the Isle of Wight, is almost indistinguishable from the present form in ornament and suture-line, but the whorl-section increases more rapidly in width.

¶ The restoration of the inner whorl, given in fig. 1 c, is somewhat problematical. Only two or three ribs are shown (on one side only), and of these one has the inner, the other only the outer, tubercle preserved.

\*\* *Loc. cit.* (1906), pl. i, fig. 8.

Delagoa Bay form than is Kilian's "*D. cornuelianum*," cited above, to the specimens of the same species figured by Sinzow.\*

Kilian † put "*D.*" *martini*, var. *gottschei*, into the group of "*D.*" *martini*, but if the present specimen is correctly identified with Krenkel's Ammonites, the character of the outer whorl and the suture-line approach the South African form more to the *cornuelianum* group. The writer, therefore, has raised this variety to an independent species. There is no differentiation of the peripheral area as there is in the *martini* group, e.g. in "*D.*" *martini*, var. *orientalis*, Jacob.‡

*Ch. kiliani*, v. Koenen sp.,§ differs in suture-line, but is close to the South African form as regards costation. The lateral tubercle, however, persists on some of the ribs in v. Koenen's species, and the whorl-section is less depressed.

The suture-line (only the last one or two are visible, in addition to the immature ones at a diameter of 4 mm.) is characterised by a high external saddle and a very wide lateral saddle. The leaflets subdividing the equally wide lateral lobe are unusually large, and there is good agreement with the suture-lines of *Ch. cornuelianum* and *Ch. meyendorffi* (d'Orbigny) in Sinzow.|| This type of suture-line distinguishes the form here described from the somewhat similar *Acanthoplites* of the *aschillaensis-bigoureti-bergeroni* group¶ of a higher horizon, but it is interesting to note that in a still later group, namely that of *Acanthoceras gillairei*, Pervinquière\*\* and *A. euomphalus* (Sharpe),†† this wide lateral lobe with its prominent, median saddle‡‡

\* *Ibid.*, pl. i, figs. 1 and 2.

† *Loc. cit.* (1913), p. 310.

‡ In Jacob and Tobler, "Gault de la Vallée de l'Engelberger Aa," 'Mém. Soc. Pal. Suisse,' vol. xxxiii (1906), pl. i, figs. 1-3.

§ *Loc. cit.* (1902), p. 406, pl. xxxiii, figs. 1 a and b.

|| *Loc. cit.*, text-figs. 1 and 2, pp. 160 and 164.

¶ See Seunes, "Amm. du Gault," 'Bull. Soc. Géol. France' (3), xv (1887), pls. xii-xiv; and Anthula, "Kreidefoss. d. Kaukasus," 'Beitr. Pal. Öst.-Ung.,' xii (1899), pls. ix-xiii.

\*\* *Cf. loc. cit.* (1907), text-fig. 108 on p. 286.

†† "Foss. Moll. Chalk," 'Mon. Pal. Soc.,' II (1854), p. 31, pl. xiii, figs. 4 a-c.

‡‡ See Crick, "Note on *A. euomphalus*," 'Geol. Mag.,' n.s., dec. iv, vol. vi (1899), pp. 252-3. A specimen of this rare species in the writer's collection has the lateral saddle rather larger than the saddle subdividing the lateral lobe, which, in Crick's figures, might be mistaken for the former. Sharpe's fig. 4c represents the relative sizes more accurately. This type of suture-line is a development of that of *Acanthoceras cunningtoni*, Sharpe sp., and of *A. sussexiense*, Mantell sp. (Sharpe, *loc. cit.*, pl. xv, figs. 1 d and 2 c), and the resemblance to *Douvilleiceratidæ* is a case of convergence.

is found again. The inner whorls of the present example, however, show that the resemblance with certain Acanthoceratids, notably *Calycoeras naviculare*, Mantell sp.\* is quite superficial.

The Persian example of "*Acanthoceras cornucli*" recorded by H. Douville† is much more coarsely costate than the specimen here described.

The very large *Douvilleiceras*, referred to on pp. 220 and 303 as coming from the South Branch of the Manuan Creek, belongs to a different group of forms. It somewhat resembles the large (and more rapidly increasing) "*Pachydiscus*" *Waageni*, Anthula,‡ in its closely costate outer whorl, but appears to be a development of the Albian *mammillatum* group (as far as can be judged by the poorly preserved younger whorls), and possibly is a very large example of the form figured by Etheridge.§ It does not appear to have anything to do with the Aptian form here described.

\* Also recorded from Madagascar, though the two forms figured by Boule, Lemoine and Thévenin (*loc. cit.*, 1907, p. 30, pl. viii, figs. 1 and 2) are very doubtful. Fig. 2 may be a *Mantelliceras*, with smooth ventral area on the inner whorls, whereas *Calycoeras*, which is a post-*Metacanthoplites* stock, has a median row of tubercles in the young. In *Calycoeras gentoni* (Brongniart = Sharpe's figs. 3 and 5, pl. xviii) all the ventral tubercles disappear at about the same time ('Pal. Univ.' 1911, No. 223); in *C. naviculare*, Mantell sp. (lectotype, Sharpe's figs. 1 and 8, pl. xviii (B.M. No. 36834), Mantell's original being useless), the two ventro-lateral rows persist longer than the median row. Mantell's type, refigured in a posthumous paper by Crick ("*A. navicularis*, Mantell," 'Proc. Mal. Soc.' vol. xiii, 1919, pp. 154-160, pl. iv) is too worn and scraped about to show any tubercles, and the writer believes that what Crick (p. 157) had considered as differences of specific value cannot be relied on, some of the ribs being artificially carved, or at least scraped, and the original shape of the whorl is quite unrecognisable. The resemblance to the Indian and Portuguese forms, which are very tumid-whorled, and to d'Orbigny's figure may not be so great as appears from a comparison of the figures, and in India, as in the English Chalk, a number of undescribed forms of *Calycoeras* occur; for Stoliezka (p. 74) states that "there are specimens which have scarcely any trace of either lateral or dorsal tubercles, even in the youngest stages." *i. e.* forms near to *C. baylei*, Pervinquière (= *A. sarthacense*, Bayle). Peron and Pervinquière had drawn attention to the similarity between *Calycoeras* of the Cenomanian and the Turonian *Fagesia*. Crick (in coll.) had labelled Mantell's type "*Fagesia navicularis*," but since he did not refer to this genus in his last paper, he probably came to the conclusion that the specimen, after all, was a Cenomanian "*Acanthoceras*," as he did in his earlier work on the False Bay fauna (p. 205).

† "Mission Scientif. Perse, Morgan," vol. iii, "Et. Geol.," pt. iv, 'Pal.' 1904, p. 231, pl. xxviii, figs. 1 a, b.

‡ *Loc. cit.*, p. 106, pl. ix, figs. 1 a, b, Sinzow (*loc. cit.*, 1906), p. 164, pl. i, fig. 10 (as *Douvilleiceras meyerdorffi*, var. *waageni*).

§ *Loc. cit.* (Third Report), pl. v, fig. 1. There also is a resemblance to Choffat's *Acanthoceras marques-costai* ('Conducia,' 1903, p. 27, pl. vii, fig. 2), but this form is compared with Cenomanian Ammonites.

Hyatt's genus *Chelonicerus* is adopted for these Aptian forms since the genus *Douvilleicerus* should be restricted to the Albian *manmillatum* group. According to Kilian\* the group of "*Douvilleicerus*" *royerianum*, d'Orbigny sp. (= type of *Chelonicerus*), is closely connected with the *martini* and *albrechti-austriacae* groups (to which last the form here described belongs), and not with the group of "*D.*" *bigoureti*, which "leads to *Acanthoplites*." The relations of these Aptian forms with the Barremian *Paraspiticeras* have yet to be worked out. Sinzow† would include the type of *Paraspiticeras* (*P. percerali*, Uhlig sp.) with the Aptian *Ch. meyendorffi*, d'Orbigny sp.,‡ but in the writer's opinion the two developments are distinct.

3. CHELONICERAS (ACANTHOPLITES?) DELAGOENSE. Krenkel sp.  
(Pl. XXVI, figs. 2 a-d.)

1910. *Douvilleicerus delagoense*, Krenkel. "Aptfossil. d. Delagoa Bai," N. Jb. f. Min., etc. (i), p. 147, pl. xvii, figs. 6 and 7.

A small example (No. 5118), showing very good agreement with Krenkel's species, by its suture-line belongs to the same group of forms as the specimen last described, but in loss of tuberculation, and in the costation of the outer whorl, one-third of which already belongs to the body-chamber, it has a superficial resemblance to the genus *Acanthoplites*. The dimensions are as follows:

Diameter	. . . . .	22	mm.
Height of the last whorl	. . . . .	37	per cent. of the diameter.
Thickness	.. .. .	48	.. .. .
Umbilicus	. . . . .	40	.. .. .

At a diameter of 7.5 mm., at which the suture-line represented in fig. 2 c was taken, the whorl-section is depressed, and there are constrictions as in *Chelonicerus royerianum*, d'Orbigny sp., and in the specimen last described. The point of bifurcation of the ribs is marked by a tubercle at this stage, as in *Chelonicerus seminodosum*, Sinzow sp.,§ or in *Acanthoplites Bigoureti* (Seunes), Jacob,|| and the

\* *Loc. cit.* (1913), p. 340.

† *Loc. cit.* (1906), p. 163.

‡ See also 'Pal. Univ.,' 1911, pl. ccix.

§ "Besch. einiger *Douvilleicerus*-Arten a. d. Ob. Neocom. Russl.," Verh. Russ. Kais. Mineral. Ges. (2), vol. xlv (1906), p. 165, pl. i, fig. 3 only.

|| "Gisement de Clansayes," Bull. Soc. Géol. France' (4), v, pl. xiii, figs. 6 a, b.



intermediate ribs also may have a tubercle at this point, even when single, giving the inner whorls a coronate appearance. After a diameter of 10 mm., however, all tuberculation is lost, whereas Krenkel's type shows the last tubercle only at a diameter of 15 mm. This loss of tuberculation is a feature found in certain varieties of "D." *tchernyschewi*, Sinzow,\* but much more typically shown in certain *Acanthoplites*. *A. bigoti* (Seunes), Sinzow sp.,† e.g., has a very similar outer whorl; and the suture-lines of this form, and of *A. bigoureti*, Seunes sp., as figured by Jacob,‡ are not very different from that of the present specimen. Seunes's type,§ however, and the form figured by Pervinquière,|| are less closely comparable. On the other hand, the small example of *Ch. seminodosum*, the lateral and peripheral views of which, as figured by Sinzow, greatly resemble the (somewhat less depressed) South African form, instead of losing the original tubercle, takes on a second one, that is to say, it becomes a more closely costate type of *Ch. cornuelianum*.

The suture-line corresponds with that found in certain *Acanthoplites*, i.e. the *bigoureti-bergeroni* group, and with that of the *cornuelianum-meyendorffi* group, referred to above; also with that of *Ch. hambrovi*, Forbes sp.¶ Those of the typical *Acanthoplites* (*aschiltuensis* group)\*\* and of the true *Parahoplites* (*melchioris*-group)†† are different.

There is no close resemblance to any of the various forms of the South American Aptian (e.g. *A. roseanus*, *treffryanus*, Karsten sp.‡‡), of which there is a large series in the British Museum, and which (with forms like d'Orbigny's *A. crassicostatus*,§§ with *A. peltoceroïdes*,

\* *Loc. cit.*, e.g. pl. iii, fig. 4.

† "Unters. einiger Amm. a. d. Unt. Gault Mangyschlaks und d. Kaukasus," Verh. Russ. Kais. Min. Ges., ser. 2, vol. xlv (1907), pl. iv, fig. 18.

‡ *Loc. cit.* (Clansayes), p. 412, fig. 5; p. 415, fig. 7.

§ *Loc. cit.* (1887), pl. xii, fig. 2, p. 568.

|| *Loc. cit.* (1907), pl. vii, figs. 36 a, b.

¶ See fig. 3, pl. viii, taken at a diameter of 10 mm., from an Isle of Wight specimen in the writer's collection.

\*\* In Sinzow, *loc. cit.* (1907), pl. v, e.g. figs. 1 and 3; also *Anthula*, *loc. cit.* (1899), pl. x, fig. 3 b.

†† In Sinzow, *loc. cit.* (1907), pl. ii, figs. 1-4; also *Anthula*, *loc. cit.* (1899), pl. viii, fig. 4 c.

‡‡ "Üb. d. Geogn. Verh. d. Westl. Columb., etc.," Amtl. Ber. 32. Vers. Deutsch. Nat. F., etc., Vienna, 1858, e.g. pl. ii, fig. 4; also Lea, "Notice of Ool. Form. i. Am.," Trans. Am. Phil. Soc., Philad. (vii), n.s., 1840-1, pl. viii, figs. 4, 5.

§§ *Loc. cit.* (1840), pl. lix, figs. 1-4.

Kilian *non* Pavlow sp.,\* *A. tobleri*, Jacob sp.,† and Sinzow's various Caucasian *Acanthoplites*‡) show the peculiar ventral flattening of the costation that is only just indicated in Krenkel's species. The *Acanthoplites* of the *milletianus-jacobi* group found in North Germany (Schrammen, Collet, etc., Colls., British Museum) belong to a different group again. On the other hand, there is a superficial resemblance to certain *Calycoceras* of the Cenomanian, notably to *C. baylei*, Pervinquière, or to the form figured by Vilanova.§

Kilian|| first named this species *Acanthoceras* (*Parahoplites*) *abichi* (*Anthula*) var. *africana*, but Krenkel drew attention to the differences between the African and the Caucasian forms. The suture-line confirms this separation of *Ch. delagoense* from *Acanthoplites abichi*, which latter belongs to the *bergeroni-bigoureti* group, and was, indeed, united with the last species by Pervinquière.¶

The genus *Paraspiticas*, which shows a change to costation, following on tuberculation, does not have the slightly sigmoidal ribbing which approaches the present example so much to the inner whorls of the *Acanthoplites bigoti* figured by Sinzow (1907) on pl. iv, fig. 18.

## EXPLANATION OF PLATES XIX—XXVI.

### PLATE XIX.

FIG.

1. *Diaziceras tissotiaeforme*, gen. and sp. nov. Upper Senonian, Umkwelane Hill. Specimen No. 5478, p. 245. *a.* Side view of holotype. *b.* Peripheral view, not quite central. *c.* Sectional outline, at diameter = 50 mm. *d.* Inner whorls, at diameter = 3 mm., × 15. The keel appears at a diameter of about 2.5 mm. *e.* Adult suture-line, × 2, external portion. *f.* Internal portion of same. *g-k.* Development of suture-line, at diameters of 1.5 mm. (*g*); 2 mm. (*h*); 3 mm. (*i*); 5.5 mm. (*j*); 8 mm. (*k*). All greatly magnified.
2. *Parapuzosia* sp. nov. ? ind. Upper (?) Senonian, Railway Cutting, Umfolozi. Specimen No. 5513, p. 224. Reduced about  $\frac{1}{4}$ . After a photograph sent by Dr. A. L. du Toit.

\* Pavlow's form ('Argiles de Speeton,' 1892, p. 152, pl. xi, figs. 20 and 21), according to specimens in the British Museum and information kindly given by Mr. Lamplugh, does not belong to this family and formation.

† *Loc. cit.* ('Engelberger Aa,' 1906), p. 11, pl. ii, figs. 4-6 (*Parahoplites*).

‡ *Loc. cit.* (1907), pl. v.

§ 'Mem. Geogn. d. Castellon,' pl. ii, fig. 5 (as *A. mantelli*). The *A. cornuelianus* (*ibid.*, fig. 11) of this author is considered by Kilian (1913, p. 341) to belong, probably, to *Ch. albrechti-austriacae*, Hohenegger sp.

|| *Loc. cit.* (1902), p. 465.

¶ *Loc. cit.* (1907), p. 195.

## PLATE XX.

FIG.

1. *Parapuzosia*, sp. nov. ? ind. (Specimen figured Pl. XIX, fig. 2.) Reduced  $\frac{2}{3}$ . Photograph by Dr. A. L. du Toit. With restored outline-section (1 a), p. 224.
2. *Pseudoschloenbachia umbulazi*, Baily sp. Upper Senonian, Umkwelane Hill. Specimen No. 5494, p. 240. (Genotype.)
3. *Pseudoschloenbachia umbulazi* (Baily) var. *acuta*, nov. Same locality and formation. Specimen No. 5450, p. 241. 3 a. Peripheral view.
4. *Mortoniceras soutoni* (Baily). Umtamvuna River, Natal. B.M., No. C19441. Suture-line, after a drawing by the late G. C. Crick. (See p. 234.)

## PLATE XXI.

1. *Mortoniceras woodsi*, sp. nov. Upper Senonian, Umkwelane Hill. Specimen N. 5451, p. 232. a. Side view. b. Peripheral view, not quite central. c. Suture-line (restored),  $\times 2$ . Ventral lobe on left, antisiphonal lobe on right. d. Sectional outline.
2. *Platoniceras subkaffrarium*, sp. nov. Same locality. Senonian. No. 5106, p. 247. a. Side view. b. Peripheral view, not quite central. c. Sectional outline. d. Portions of suture-line,  $\times 3$ , showing ventral lobe (arrow on right) and umbilical tubercle (left).

## PLATE XXII.

1. *Parapachydiscus* sp. n. aff. *colligatus*, Binkhorst sp.,  $\times \frac{1}{2}$ . Upper Senonian, Umkwelane Hill. No. 5489, p. 226. Side and peripheral views.
2. *Nostoceras natalense*, sp. nov. No. 2746. Upper Senonian, Umfolozi Valley, East of Railway, p. 248. a. Side view. b. Top view.
3. *Nostoceras subangulatum*, sp. nov. No. 2746A. Same locality and formation, p. 250. a. Side view. b. Septal surface at \* in fig. 3 a,  $\times 2$ . D. = dorsal, V. = ventral side, I.Z. = impressed zone. c. Suture-line,  $\times 4$  (restored), at \* in fig. 3 a.

## PLATE XXIII.

1. *Peroniceras* cf. *dravidicum*, Kosmat sp. Lower Senonian. High ground on north side of United Manuan Creek and Umsinene River, almost opposite junction. No. 4950, p. 295. a. Side view. b. Peripheral view. c. Sectional outline. d. Suture-line,  $\times 2$ .
2. *Peroniceras* cf. *czörnigi*, Redtenbacher sp. (= *Peroniceras u* of Crick, 1907, p. 226, text-fig. on p. 226). B.M., No. C18245. Lower Senonian, Zululand. (See p. 296.) Internal (dorsal) portion of suture-line showing considerable asymmetry.
3. *Mortoniceras stangeri*, Baily sp. Senonian, Umtamvuna River, Natal. (See p. 297.) a. Sectional outline of No. C19459 (British Museum),  $\times 2$ , at diameter = 25 mm. b. Portion of suture-line of same specimen, from lateral saddle (left) to antisiphonal line (right). U. = umbilical suture. (At diameter = 125 mm.) c. Internal suture (at diameter = 60 mm.) of Baily's co-type, 11368A (Geol. Soc. Coll.).

## FIG.

4. *Mortoniceras vanuxemi*, Morton (Whitfield) sp. Upper Senonian, North-west shore of False Bay. No. 4947, p. 308. *a*. Sectional outline. *b*. Suture-line,  $\times 3$ . The dotted line on the right of the fig. 4*a* denotes the position of the antisiphonal lobe.
5. *Diplomoceras ? indicum*, Forbes sp. Upper Senonian, Umkwelane Hill. No. 5465, p. 256.

## PLATE XXIV.

1. *Parapachydiscus* cf. *wittekindi*, Schlüter sp. Upper Senonian, Umfolozi Valley, East of Railway. No. 3969, p. 229,  $\times \frac{2}{3}$ .
2. *Bostrychoceras* ? sp. ind. Upper Senonian, Umkwelane Hill. No. 5478A, p. 255. (Squeeze of impression in matrix of *Diaziceras tissotiaeforme*.)
3. *Parapuzosia*, sp. nov. ? ind. Senonian, Railway Cutting, Umfolozi. Specimen figured, Pl. XIX, fig. 2, Pl. XX, fig. 1, p. 224. Cast of dorsal impression in outer whorl, showing ornamentation of missing inner whorls,  $\times \frac{1}{2}$ .
4. *Baculites* cf. *aspero-anceps*, Lasswitz. Upper Senonian, Umkwelane Hill. No. 5480, p. 259. 4*a*. Sectional outline.
5. *Baculites* cf. *brericosta*, Schlüter. Same locality and formation. No. 5461, p. 260. 5*a*. Sectional outline.
6. *Baculites capensis*, Woods. Same locality and formation. Suture-line of specimen No. 5486, p. 257,  $\times 6$ .
7. *Baculites capensis*, Woods. Upper Senonian, Untamvuna River, Pondoland. B.M., C19420. After a drawing by the late G. C. Crick (see p. 258),  $\times 2$ .
8. *Kossmaticeras (Madrasites) bhavani*, Stoliczka sp. Senonian, south side of Manuan Creek Valley. No. 4909, p. 299.
9. *Subschloenbachia bispinosa*, nov. Upper Albian, Middle Branch, Manuan Creek. No. 4993, p. 285. (Sectional outline, restored.)
10. *Subschloenbachia prerostrata*, nov. Upper Albian, Middle Branch, Manuan Creek. No. 4970, p. 284. (Sectional outline.) The arrows indicate the spiral grooves of the cast, not visible on the shell.

## PLATE XXV.

1. *Pseudophacoceras manuanense*, nov. Albian, Manuan Creek (p. 281). *a*. Side view of holotype, No. 2725,  $\times \frac{1}{2}$ . *b*. Suture-line of same, at diameter = 160 mm. *c*. Side view of specimen No. 2726. *d*. Sectional outline of same.
2. *Dipoloceras cristatum*, Deluc sp. Albian, Manuan Creek. No. 2728, p. 277. Mouth-border of very large example, taken from a cast of impression in matrix.
3. *Dipoloceras quadratum*, nov. Albian, Middle Branch, Manuan Creek. No. 4955, p. 278. *a, b*. Side and peripheral views. *c*. Sectional outline.
4. *Subschloenbachia* cf. *trinodosa*, Böse sp. Uppermost Albian, south side of Manuan Creek Valley. No. 4972, p. 285. Sectional outline.

## PLATE XXVI.

FIG.

1. *Chelonicerus gottschei*, Kilian sp. Aptian, Powell's Camp, Upper Catembe. Specimen No. 5117, p. 312. *a*. Side view of body-chamber portion. *b*. Peripheral view of same. *c*. Restored sectional outline of inner whorl. *d*. Suture-line, restored from last two, at beginning of portion figured in 1 *a* (at \*),  $\times \frac{5}{3}$ .
2. *Chelonicerus (Acanthoplites?) delagoense*, Krenkel sp. Same formation and locality. No. 5118, p. 316. *a, b*. Side and peripheral views. *c*. Suture-line, at diameter = 7.5 mm. (where whorl is coronatiform and constricted),  $\times 6$ . *d*. Same at 15 mm. *l*. = antisiphonal line,  $\times$  about 6.
3. *Chelonicerus hambrovi*, Forbes sp. Aptian, Atherfield Clay, Isle of Wight. (Writer's Coll.) Suture-line, at diameter = 10 mm.,  $\times 6$ . (See p. 317.)
4. *Aconeceras nisoides*, Sarasin sp. Aptian, Powell's Camp. No. 5119, p. 311. Side view (4*a*) and sectional outline (4*b*).
5. *Dipoloceras* sp. nov.? Albian, Middle Branch, Manuan Creek. No. 4903, p. 280. *a*. Side view, with restored outline of complete shell. *b*. Sectional outline, showing peculiar keel.
6. *Dipoloceras cristatum*, Deluc sp. Albian, Manuan Creek. Portion of suture-line,  $\times 2$ , of specimen 2728, p. 277. *l*. = antisiphonal line, with keel of previous whorl (impossible to remove) concealing internal lobe.
7. *Anisoceras* sp. ind. Albian? Low Ridge, about three miles east of foot of Lebombo Mountains, north of M'Kusi River, due east of Ubombo. No. 4982, p. 288. Suture-line,  $\times 8$ .